BUFFALO RIVER

Water Quality Improvement Plan

A plan to reduce bacterial contamination and sediment loads

Technical Document

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Prepared by

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1. INTRODUCTION

1.1 Background

The 1972 Clean Water Act (CWA) requires that streams, rivers, and lakes meet their state's water quality standards. The CWA also requires that states conduct monitoring to identify those waters that do not meet standards. Under the CWA, Virginia has determined that many streams do not meet state water quality standards for the protection of the five designated uses: fishing, swimming, shellfish, aquatic life, and drinking.

When streams fail to meet water quality standards, Section 303(d) of the CWA and the U.S. Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation both require that states develop a Total Maximum Daily Load (TMDL) for each offending pollutant. A TMDL is a "pollution budget" that sets limits on the amount of pollution that a waterbody can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. A TMDL accounts for seasonal variations and must include a margin of safety. Through the TMDL process, states establish water-quality based controls to reduce pollution and meet water quality standards.

Once a TMDL is developed, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA) requires development of an 'implementation plan' to achieve fully supporting status for impaired waters. A TMDL implementation plan (IP) describes the pollutant control measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), which need to be implemented in order to meet the water quality goals established in the TMDL.

1.2 Designated Uses and Applicable Water Quality Standards

Water quality standards are designed to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.). Virginia Water Quality Standard 9 VAC 25-260-10 (Designation of uses) states:

All state waters, including wetlands, are designated for the following uses: recreational uses, e.g., swimming and boating; the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources, e.g., fish and shellfish.

1.2.1 Bacteria Water Quality Criterion (9 VAC 25-260-170)

In order to protect human health during primary contact recreation (e.g., swimming), the Commonwealth of Virginia has set limits on the amount of specific fecal bacteria in all state waters. The bacteria criterion for freshwater that was in place when Buffalo River was listed as impaired in 2006 was based on *Escherichia coli (E. coli)*. At the time of the listing, for a non-shellfish supporting water body to be in compliance with the Virginia *E. coli* bacteria standard for contact recreational use, the following criteria (Virginia Water Quality Standard 9 VAC 25-260-170) apply:

E. coli bacteria shall not exceed a geometric mean of 126 colony forming units (cfu)/100 mL in freshwater. If there are insufficient data to calculate monthly geometric means in freshwater, no more than 10.5% of the total samples in the assessment period shall exceed 235 *E. coli* cfu/100mL.

Four segments of Buffalo River (VAW-H11R_BUF01A00, VAW-H11R_BUF02A00, VAW-H11R_BUF03A00, VAW-H11R_BUF04A08) were listed as impaired on Virginia's 2010 Section 305(b)/303(d) Water Quality Assessment Integrated Report due to water quality exceedances of the *E. coli* and/or fecal coliform standard. Mill Creek (VAW-H11R_MIN01A08), Turner Creek (VAW-H12R_TNR01A08) and Rutledge Creek (VAW-H12R_RTD01A00), all tributaries in the Buffalo River watershed were also listed due to water quality exceedances of the *E. coli* standard on Virginia's 305(b)/303(d) Water Quality Assessment Integrated Report between 2008 and 2012.

The bacteria TMDLs for Buffalo River and tributaries were developed to not exceed the *E. coli* monthly geometric mean criterion of 126 cfu/100mL, and with an exceedance rate (percentage of samples) of less than 10.5% of the *E. coli* single sample maximum assessment criterion of 235 cfu/100mL (VDEQ, 2013a). Meeting this target provided consistency with Virginia Department of Environmental Quality (DEQ) assessment guidance (VDEQ, 2017a).

Since development of the bacteria TMDLs, four additional segments within the Buffalo River watershed have been listed as impaired on Virginia's 2014 305(b)/303(d) Water Quality Assessment Integrated Report due to exceedances of the *E. coli* standard; Rutledge Creek (VAW-H12R_RTD03A14) and Buffalo River (VAW-H11R_BUF03B14, VAW-H12R_BUF01A00, VAW-H12R_BUF02A02).

In 2019, the Virginia State Water Control Board adopted EPA's nationally recommended bacteria criteria. For *E. coli*, the criteria include a geometric mean value never to exceed 126 bacteria colony counts per 100 milliliters (counts/100mL) and no more than 10% of samples allowed to exceed a statistical threshold value of 410 counts/100mL within a 90-day period. It is expected that the reductions needed to meet the TMDL will also meet the new standard.

1.2.2 Aquatic Life Water Quality Criterion (9 VAC 25-260-20)

The water quality standard supported through biological monitoring is Virginia's narrative General Standard (9 VAC 25-260-20), also known as the Aquatic Life Use standard, which states in part:

State waters, including wetlands, shall be free from substances attributable to sewage, industrial waste, or other waste in concentrations, amounts, or combinations which contravene established *standards or interfere directly or indirectly with designated uses of such water or which are … harmful to human, animal, plant, or aquatic life.*

Specific substances to be controlled include, but are not limited to: floating debris, oil scum, and other floating materials; toxic substances (including those which bioaccumulate); substances that produce color, tastes, turbidity, odors, or settle to form sludge deposits; and substances which nourish undesirable or nuisance aquatic plant life. Effluents which tend to raise the temperature of the receiving water will also be controlled. (SWCB, 2011)

The biological monitoring program in Virginia used to evaluate compliance with the above standard is run by DEQ. Evaluations of monitoring data from this program focus on the benthic (bottom-dwelling) macro (large enough to see) invertebrates (insects, mollusks, crustaceans, and annelid worms) and are used to determine whether or not a stream segment has a benthic impairment. Changes in water quality generally result in alterations to the quantity and diversity of the benthic organisms that live in streams and other water bodies. In addition to being the major intermediate constituent of the aquatic food chain, benthic macroinvertebrates are "living recorders" of past and present water quality conditions. This is due to their relative immobility and their variable resistance to the diverse contaminants that are introduced into streams. The community structure of these organisms provides the basis for the biological evaluation of water quality.

Long Branch and Buffalo River were originally listed as impaired due to water quality exceedance of the general aquatic life (benthic) standard in the 2008 Virginia Water Quality Assessment 305(b)/303(d) Integrated Report (VDEQ, 2008). DEQ has identified these benthic impairments as 3.40 miles on Long Branch (stream segment VAW-H11R_LOB01A04) and 1.96 miles on Buffalo River (stream segment VAW-H11R_BUF04A08). The Long Branch impaired segment runs from the headwaters downstream to its confluence with Buffalo River and the Buffalo River benthic impaired segment runs from its confluence with Long Branch downstream to its confluence with Franklin Creek.

Based on the stressor analysis, the most probable stressor contributing to the impairments of the benthic community in Long Branch and Buffalo River is sediment. Sediment TMDLs were developed to address the Long Branch and Buffalo River biological impairments (VDEQ, 2013b).

1.3 Attainability of Designated Uses

1.3.1 Bacteria Water Quality

All waters in the Commonwealth have been designated as "primary contact" for the swimming use regardless of size, depth, location, water quality or actual use. The bacteria standard described in Section 1.2.1 of this report is to be met during all stream flow levels and was established to protect bathers from ingestion of potentially harmful bacteria. However, many headwater streams are small and shallow during base flow conditions when surface runoff has minimal influence on stream flow. Even in pools, these shallow streams do not allow full body immersion during periods of base flow. In larger streams, lack of public access often precludes the swimming use.

Recognizing that all waters in the Commonwealth are not used for swimming, Virginia has approved a process for re-designation of the swimming use for secondary contact in cases of: 1) natural contamination by wildlife, 2) small stream size, and 3) lack of accessibility to children, as well as due to widespread socio-economic impacts resulting from the cost of improving a stream to a “swimmable” status.

The re-designation of the current swimming use in a stream requires the completion of a Use Attainability Analysis (UAA) study. A UAA is a structured scientific assessment of the factors affecting the attainment of the use, which may include physical, chemical, biological, and economic factors as described in the Federal Regulations. The stakeholders in the watershed, relevant Virginia state agencies, and EPA all have the opportunity to comment on UAA studies.

In some streams for which TMDLs have been developed, water quality modeling indicates that even after removal of all of the sources of *E. coli* (other than wildlife), the stream will not attain the applicable water quality standards. In such cases, after demonstrating that the source of *E. coli* contamination is natural and uncontrollable by reasonable control measures, Virginia may decide to re-designate the stream’s use for secondary contact recreation or to adopt site specific criteria based on natural background levels of *E. coli*. All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. Watershed stakeholders and EPA will be able to provide comment during this process.

1.3.2 Aquatic Life Water Quality

Although the Buffalo River and Long Branch TMDLs were developed for sediment, attainment of a healthy benthic community will ultimately be based on biological monitoring of the benthic macroinvertebrate community, in accordance with established DEQ protocols. If a future review should find that the reductions called for in these TMDLs based on current modeling are found to be insufficiently protective of local water quality, then revision(s) will be made as necessary to provide reasonable assurance that water quality goals will be achieved.

2. REQUIREMENTS FOR IMPLEMENTATION PLANS

There are a number of requirements and recommendations for TMDL IPs. The goal of this chapter is to clearly define what they are and explicitly state if the "elements" are a required component of an approvable IP or are merely a recommended topic that should be covered in a thorough IP. This chapter discusses a) the requirements outlined by WQMIRA that must be met in order to produce an IP that is approvable by the Commonwealth, b) IP elements recommended by the EPA, and c) components of an IP required in Section 319 of the CWA.

2.1 State Requirements

The TMDL IP is a requirement under WQMIRA which directs the State Water Control Board (SWCB) to "develop and implement a plan to achieve fully supporting status for impaired waters." In order for IPs to be approved by the Commonwealth, they must meet the requirements outlined in WQMIRA (VDEQ, 2017b), including:

- date of expected achievement of water quality objectives,
- measurable goals,
- necessary corrective actions, and
- associated costs, benefits, and environmental impact of addressing the impairment.

2.2 Federal Recommendations

Section 303(d) of the CWA and current EPA regulations do not require the development of TMDL IPs. The EPA does, however, outline the minimum elements of an approvable IP in its 1999 *Guidance for Water Quality-Based Decisions: The TMDL* Process (USEPA, 1999):

- a description of the implementation actions and management measures,
- a time line for implementing these measures,
- legal or regulatory controls,
- the time required to attain water quality standards, and
- a monitoring plan and milestones for attaining water quality standards.

It is strongly suggested that the EPA recommendations be addressed in the IP, in addition to the components required by WQMIRA.

2.3 Requirements for Section 319 Fund Eligibility

The EPA develops guidelines that describe the process and criteria used to award CWA Section 319 nonpoint source grants to States. The guidance is subject to revision and the most recent version should be considered for IP development. The "Nonpoint Source Program and Grant Guidelines for States and Territories" (USEPA, 2013) identifies the following nine elements that must be included in the IP to meet the 319 requirements:

1. Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;
2. Estimate the load reductions expected to achieve water quality standards;
3. Describe the NPS management measures that will need to be implemented to achieve the identified load reductions;
4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan.
5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;
8. Identify a set of criteria for determining if loading reductions are being achieved and if progress is being made towards attaining water quality standards; if not, identify the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of the implementation effort.

3. REVIEW OF TMDL DEVELOPMENT

3.1 Background

One segment of Rutledge Creek (VAW-H12R_RTD01A00) was first listed as impaired on Virginia's 2002 Section 303(d) Report on Impaired Waters due to water quality exceedances of the fecal coliform standard (VDEQ, 2002). Mill Creek (VAW-H11R_MIN01A08) and Turner Creek (VAW-H12R_TNR01A08) were first listed as impaired on the 2008 Virginia Water Quality Assessment 305(b)/303(d) Integrated Report (VDEQ, 2008) and four segments of the Buffalo River (VAW-H11R_BUF01A00, VAW-H11R_BUF02A00, VAW-H11R_BUF03A00, and VAW-H11R_BUF04A08) were first listed as impaired on Virginia's 2010 303(d) Report on Impaired waters (VDEQ, 2010) due to exceedances of the *E. coli* standard. Long Branch (VAW-H11R_LOB01A04) and a segment of Buffalo River (VAW-H11R_BUF04A08) were originally listed as impaired due to water quality exceedance of the general aquatic life (benthic) standard in the 2008 Virginia Water Quality Assessment 305(b)/303(d) Integrated Report (VDEQ, 2008).

In summary, TMDLs were developed for six segments impaired for bacteria, one segment impaired for not supporting the General (Benthic) Standard, and one segment impaired for both bacteria exceedances and not supporting the benthic standard. DEQ has described the impaired segments as presented in Table 3-1 and Figure 3-1.

The majority of the Buffalo River watershed is located in Amherst County with a small portion in Nelson County. The watershed is part of the James River Basin [USGS Hydrologic Unit Code (HUC) 02080203] and includes National Watershed Boundary Datasets JM28 (HUC 02080203601), JM29 (HUC 02080203602), JM30 (HUC 02080203603), and JM31 (HUC 02080203604). The Buffalo River watershed is approximately 98,166 acres in size. The watershed is predominantly forested (71%) (Table 3-2, Figure 3-2).

DEQ started development of the Buffalo River TMDLs in 2012, and the final TMDL reports were completed in the fall of 2013 (VDEQ, 2013a, 2013b). The TMDL reports are available by contacting the DEQ Blue Ridge Regional Office TMDL Coordinator. The bacteria TMDL study includes several additional watersheds (Tye River, Rucker Run, Hat Creek, and Piney River) in Nelson County that are not part of this TMDL IP. These watersheds are not included in order to keep the implementation plan at a scale that allows for comprehensive implementation and measurable water quality improvements. The TMDL IP for the Tye River watershed in Nelson County was completed in 2014 (VDEQ, 2014) and is available by contacting the DEQ Valley Regional TMDL NPS Coordinator.

Table 3-1. Impaired stream segments addressed in the Buffalo River TMDL implementation plan.

<table>
<tr><th>Impaired Segment</th><th>Impairment Type</th><th>Size</th><th>Initial Listing Year</th><th>Description</th><th>HUC12</th><th>VAHU6</th></tr>
<tr><td>Long Branch
VAW-H11R_LOB01A04</td><td>benthic</td><td>3.59</td><td>2008</td><td>from its headwaters to the mouth of Buffalo River</td><td rowspan="3">020802030601</td><td rowspan="3">JM28</td></tr>
<tr><td>Buffalo River
VAW-H11R_BUF04A08</td><td>E. coli/
benthic</td><td>2.09
miles</td><td>2014/
2008</td><td>confluence with Long Branch downstream to its confluence with Franklin Creek</td></tr>
<tr><td>Buffalo River
VAW-H11R_BUF03B14</td><td>E. coli</td><td>2.17
miles</td><td>2014</td><td>confluence with Stonehouse Creek to its confluence with Franklin Creek</td></tr>
<tr><td>Mill Creek
VAW-H11R_MIN01A08</td><td>E. coli</td><td>4.15
miles</td><td>2008</td><td>from its headwaters to the backwaters of Mill Creek Reservoir</td><td rowspan="5">020802030602</td><td rowspan="5">JM29</td></tr>
<tr><td>Turner Creek
VAW-H12R_TNR01A08</td><td>E. coli</td><td>4.49
miles</td><td>2008</td><td>from its headwaters to the mouth of the Buffalo River</td></tr>
<tr><td>Buffalo River
VAW-H11R_BUF03A00</td><td>E. coli</td><td>3.66
miles</td><td>2006</td><td>from the upstream end of the WQS public water supply (PWS) designation upstream to the mouth of Stonehouse Creek</td></tr>
<tr><td>Buffalo River
VAW-H11R_BUF02A00</td><td>E. coli</td><td>5.26
miles</td><td>2010</td><td>from the Town of Amherst WTP intake upstream five miles, the WQS public water supply (PWS) designation</td></tr>
<tr><td>Buffalo River
VAW-H11R_BUF01A00</td><td>E. coli</td><td>4.59
miles</td><td>2010</td><td>from Rutledge Creek mouth upstream to the Town of Amherst WTP intake</td></tr>
<tr><td>Rutledge Creek
VAW-H12R_RTD03A14</td><td>E. coli</td><td>4.16
miles</td><td>2014</td><td>confluence with Higginbottom Creek to its headwaters</td><td rowspan="2">020802030603</td><td rowspan="2">JM30</td></tr>
<tr><td>Rutledge Creek
VAW-H12R_RTD01A00</td><td>E. coli</td><td>3.32
miles</td><td>2012</td><td>from the Town of Amherst outfall downstream to its mouth on the Buffalo River</td></tr>
<tr><td>Buffalo River
VAW-H12R_BUF02A02</td><td>E. coli</td><td>5.46
miles</td><td>2008</td><td>from Rocky Creek to the dam at the Route 657 bridge</td><td rowspan="2">020802030604</td><td rowspan="2">JM31</td></tr>
<tr><td>Buffalo River
VAW-H12R_BUF01A00</td><td>E. coli</td><td>2.34
miles</td><td>2008</td><td>from its mouth on the Tye River upstream to a low water dam near Route 657</td></tr>
</table>

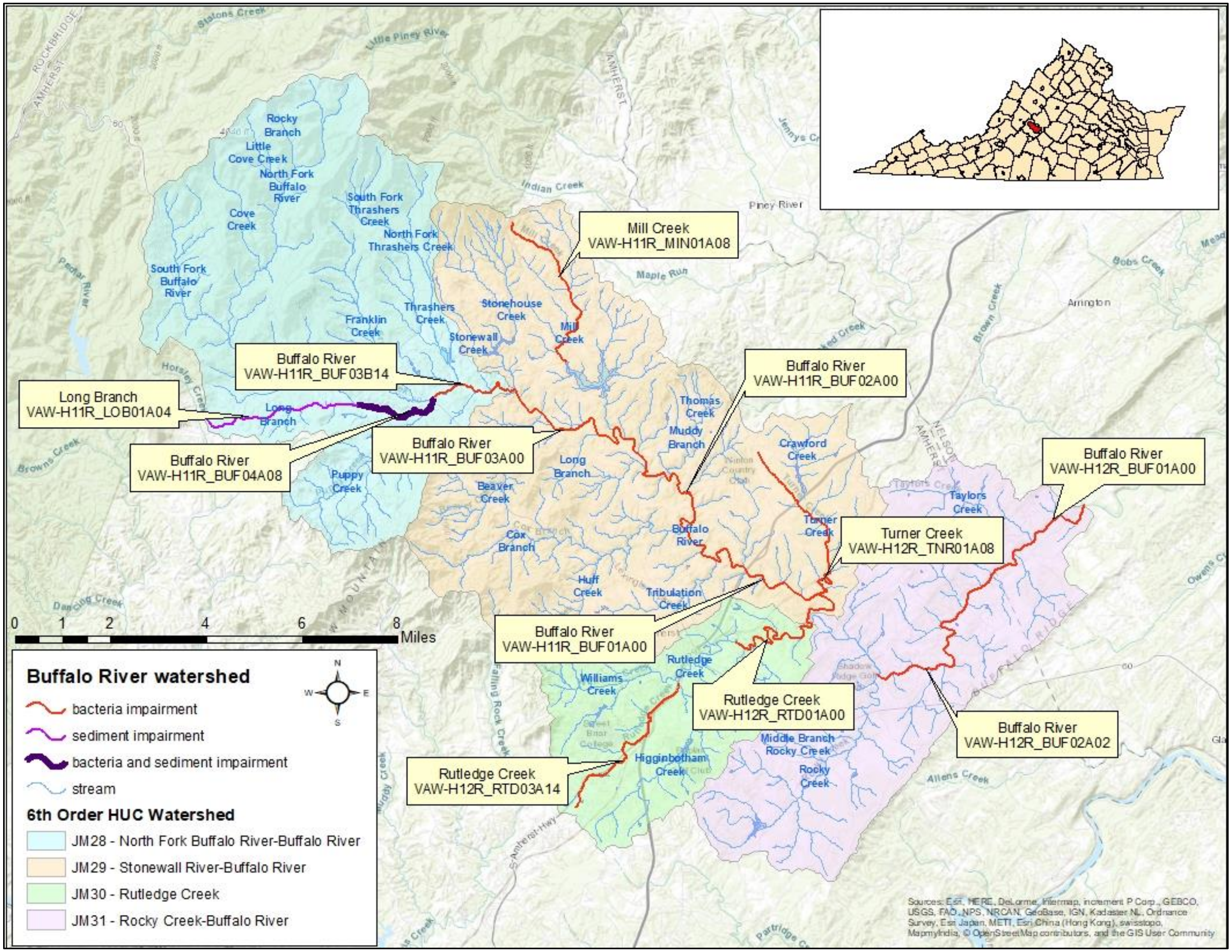

Figure 3-1. Bacteria and sediment impaired segments in the Buffalo River watershed.

Table 3-2. Land use acreage and percent total watershed acreage by land use category.

Land use*	Area	
	Acres	%
Forest	69,767	71
Agriculture	21,775	22
Residential	6,300	6
Water	324	<1
Total	**98,166**	

* From the bacteria TMDL study (VDEQ, 2013a). Source: NASS 2009 cropland data layer.

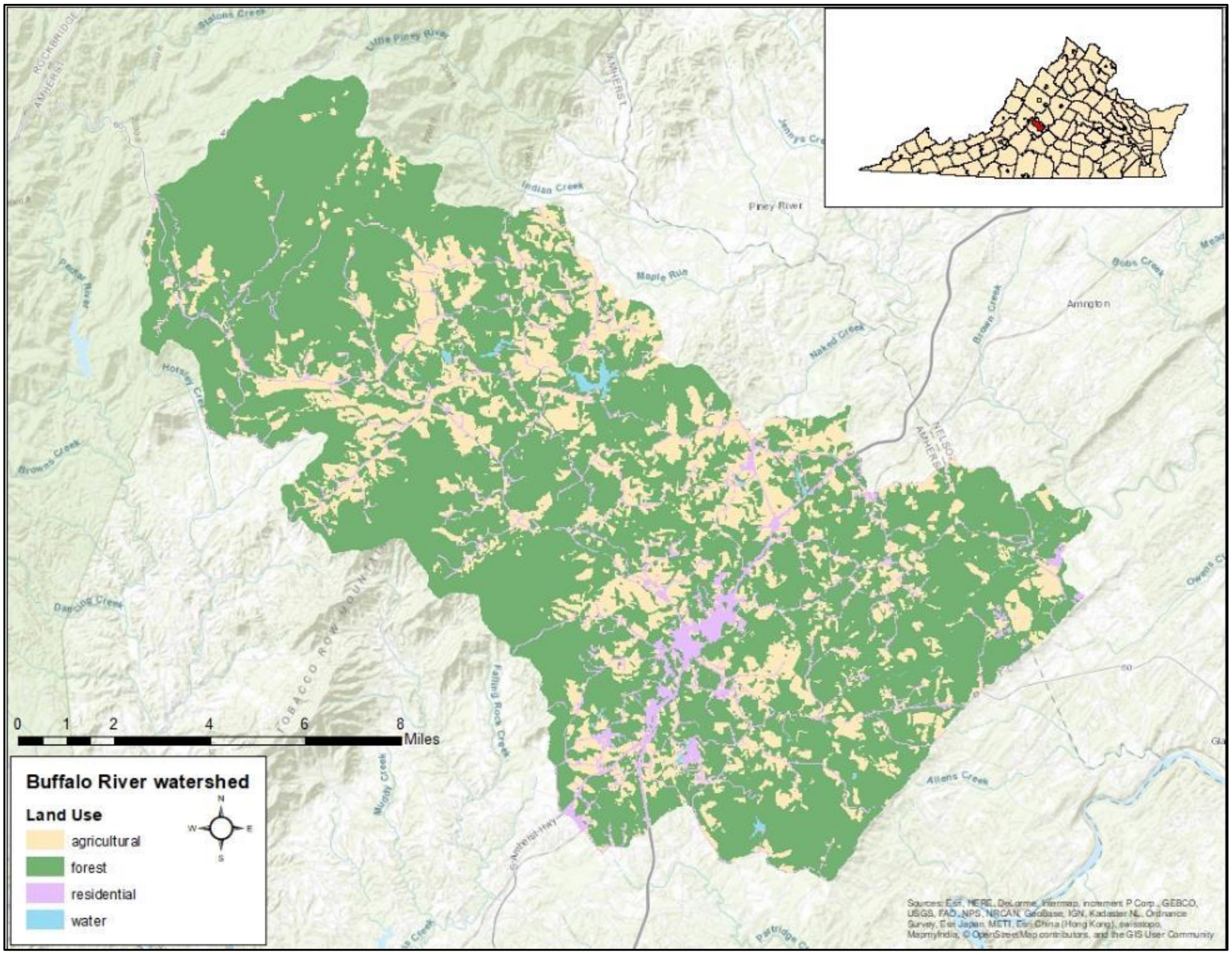

Figure 3-2. Land use in the Buffalo River watershed.

3.2 Water Quality Monitoring Data

Data collected from two biological monitoring stations, one in Long Branch and one in Buffalo River were used to list Long Branch and Buffalo River as impaired for aquatic life use and to develop the sediment TMDLs for Long Branch and Buffalo River. Data collected from seven ambient water quality monitoring stations in the Buffalo River watershed were used to list the stream segments as impaired by *E. coli*. Table 3-3 provides a summary of the data collected from these stations and Figure 3-3 shows the locations of the stations.

Table 3-3. Biological and ambient water quality monitoring stations in the impaired streams in the Buffalo River watershed.

Station ID	Stream Name	Monitoring Type	Number of Samples	Exceedance Rate*	Period of Record
2-LOB000.37	Long Branch	biological	8	50%	2001-2011
2-BUF026.43	Buffalo River	biological	8	88%	2002-2011
2-BUF026.58	Buffalo River	*E. coli*	12	58%	2011
2-BUF026.43	Buffalo River	*E. coli*	24	63%	2011-2018
2-MIN002.25	Mill Creek	*E. coli*	20	45%	2006-2010
2-TNR000.25	Turner Creek	*E. coli*	33	58%	2005-2012
2_BUF023.21	Buffalo River	*E. coli*	27	19%	2005-2010
2-BUF013.53	Buffalo River	*E. coli*	12	17%	2017-2018
2-BUF011.95	Buffalo River	*E. coli*	12	33%	2011
2-RTD007.61	Rutledge Creek	*E. coli*	12	25%	2011
2-RTD003.08	Rutledge Creek	*E. coli*	24	33%	2010-2011
2-BUF002.10	Buffalo River	*E. coli*	103	22%	2005-2019

* proportion of samples below the Virginia Stream Conditions Index of 60 for biological monitoring or above the *E. coli* single sample maximum assessment criterion of 235 cfu/100 mL for *E. coli* monitoring

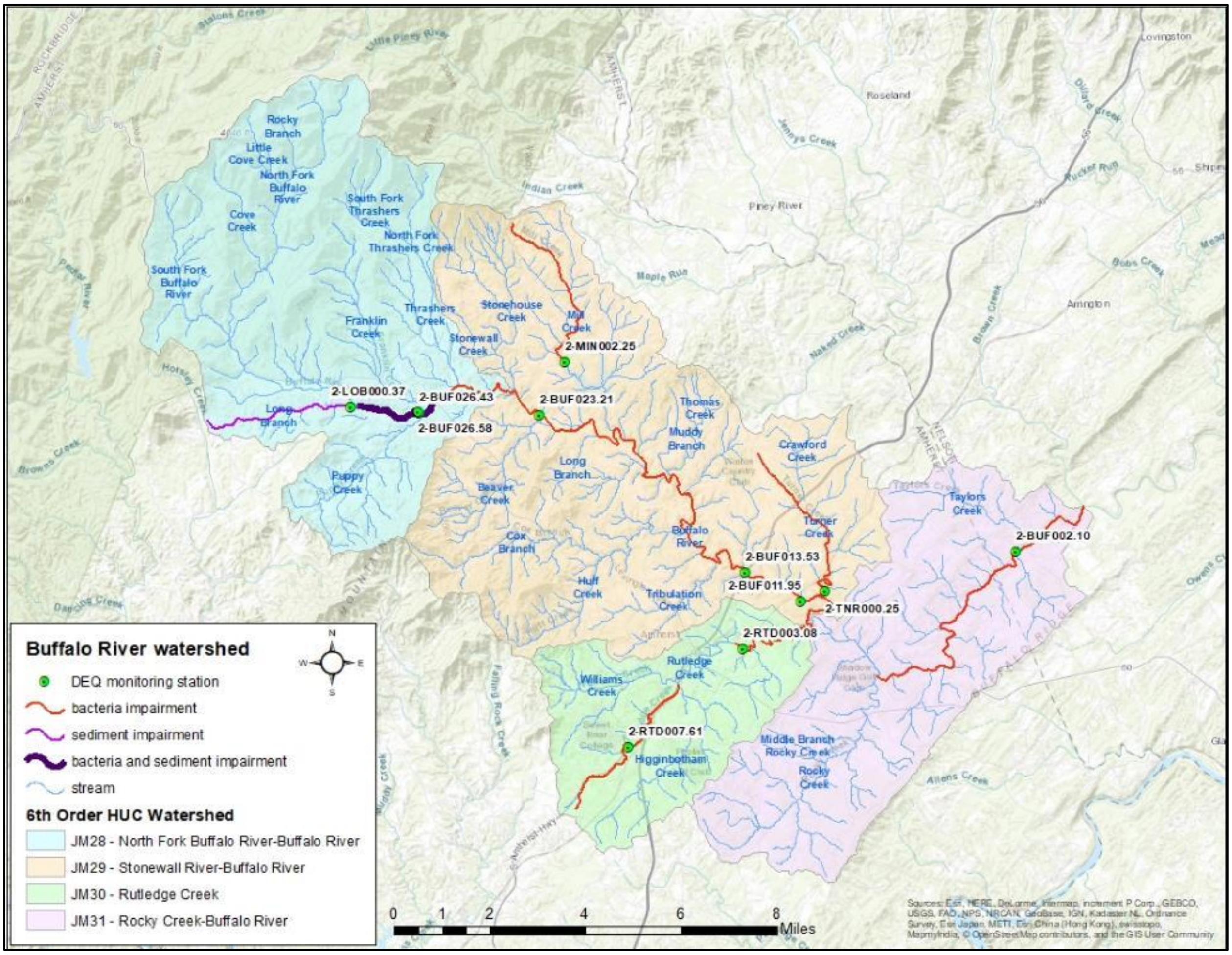

Figure 3-3. DEQ water quality monitoring stations in the Buffalo River watershed.

3.3 Water Quality Modeling

3.3.1 Bacteria

The Hydrologic Simulation Program – FORTRAN (HSPF) version 12 (Bicknell et al., 2005; Duda et al., 2001) was used to model fecal coliform transport and fate in the watersheds. ArcGIS 10 software was used to display and analyze landscape information for the development of input for HSPF. The HSPF watershed model simulates pollutant accumulation, die-off, and wash off according to the distribution of land uses, soils, and geographic features in a watershed. HSPF then simulates the routing of water and pollutants through the stream channel network, considering instream processes such as die-off. For the Buffalo River bacteria TMDLs, a source assessment of fecal coliform bacteria was performed for the watershed. Fecal coliform was then simulated as a dissolved pollutant using the HSPF model, and concentrations were translated to *E. coli* concentrations using DEQ's translator equation.

3.3.2 Sediment

Virginia does not have existing in-stream criteria for sediment; therefore, a reference watershed approach was used to define allowable TMDL loading rates in the benthic impaired Long Branch and Buffalo River watersheds. This approach pairs two watersheds: one that is supportive of their designated use(s) and one whose streams are impaired. Fishpond Creek watershed in Appomattox County was selected as the TMDL reference for both impaired watersheds. The TMDL sediment loads were defined as the modeled sediment load for existing conditions from the non-impaired Fishpond Creek watershed, area-adjusted to the benthic impaired watersheds. The Generalized Watershed Loading Function (GWLF) model (Haith et al., 1992) was used for comparative modeling for both impaired streams and Fishpond Creek.

3.4 Bacteria Source Assessment

Potential sources of bacteria considered in the development of the bacteria TMDLs included point source and nonpoint source contributions.

3.4.1 Point Sources

A TMDL's waste load allocation accounts for the portion of a receiving water's loading capacity that is allocated to one of its existing or future point sources of pollution. Point sources of *E. coli* bacteria in the watersheds include all municipal and industrial plants that treat human waste, as well as private residences that have general permits. These point sources are required to maintain an *E. coli* discharge concentration no greater than 126 cfu/100mL. Virginia issues Virginia Pollutant Discharge Elimination System (VPDES) permits for point sources. There is currently one permitted point source discharging bacteria in the Rutledge Creek watershed. In addition to the permitted point source discharge, there is also one Municipal Separate Storm Sewer System (MS4) permit within the Rutledge Creek watershed. Table 3-4 lists the permitted sources, along with the permitted discharges and waste load allocations in the TMDL. The waste load allocation for the sewage treatment plant was set at the permitted load. The MS4 permit covers the land area within permit boundaries with stormwater runoff that discharges to surface waters.

Table 3-4. Permitted bacteria point sources discharging in the Buffalo River watershed.

Permit Number	Facility Name	Permit Type	Receiving Stream	*E. coli* Load (cfu/year)
VA0031321	Rutledge Creek WWTP	VPDES IP	Rutledge Creek	1.05×10^{12}
VA0092975	Virginia Department of Transportation	MS4	Rutledge Creek	8.54×10^{9}

3.4.2 Nonpoint Sources

Nonpoint source pollution originates from sources across the landscape (e.g., agriculture and residential land uses) and is delivered to waterbodies by rainfall and snowmelt. In some cases, a precipitation event is not required to deliver nonpoint source pollution to a stream (e.g., pollution from straight pipes or livestock directly defecating in a stream). Nonpoint sources of bacteria in the watershed include failing septic systems, straight pipes, land application of manures, livestock, wildlife, and domestic pets. During TMDL development, bacteria loads were represented either as land-based loads (where they were deposited on land and available for wash off during a rainfall event) or as direct loads (where they were directly deposited into the stream). Land-based nonpoint sources are represented as an accumulation of bacteria on the land, where some portion is available for transport in runoff. The amount of accumulation and availability for transport vary with land use type and season. The maximum accumulation was adjusted seasonally to account for changes in die-off rates, which are dependent on temperature and moisture conditions. Direct loads are modeled similarly to point sources since they do not require a runoff event for delivery to the stream. Nonpoint sources of bacteria in the watershed are summarized in Table 3-5.

Table 3-5. Estimated annual nonpoint fecal coliform loadings to the land surfaces and stream by source and land use categories in the Buffalo River watershed.

Source	Fecal coliform loading (x10^{14} cfu/yr)	Percent of total loading
Direct loads to streams		
Livestock in stream	1.1	<1
Straight pipe discharges	0.1	<1
Wildlife in stream	0.8	<1
Loads to land surfaces		
Pasture	222.3	90
Livestock	*219.6*	*89*
Manure and/or Poultry Litter	*1.8*	*<1*
Wildlife	*0.9*	*<1*
Cropland	1.4	<1
Manure and/or Poultry Litter	*0.8*	*<1*
Wildlife	*0.6*	*<1*
Residential	15.5	6
Human (Septic)	*9.3*	*4*
Pet	*5.8*	*2*
Wildlife	*0.4*	*<1*
Forest	5.5	<1
Total	**246.7**	

In addition to considering total land-based loads of bacteria in the watershed, their relative contributions towards instream bacteria concentrations must also be considered during TMDL development and implementation planning. While livestock in the stream is a comparatively small bacteria load when compared to pasture, land-based loads require precipitation events to transport fecal coliform to the stream. In addition, not all of the land-based load is available for wash off since bacteria die off over time. Therefore, the relative contributions of land-based and direct sources to instream water quality are often considerably different than overall watershed loads. Table 3-6 shows how each of these sources impacts *E. coli* concentrations in the stream. The estimated average annual *E. coli* load at the Buffalo River outlet is 3.11 x 10^{14} cfu/yr and the estimated average daily *E. coli* concentration is 113 cfu/100 mL.

Table 3-6. Relative contributions of different *E. coli* sources to the overall *E. coli* concentration for existing conditions in the Buffalo River watershed.

Source	Relative Daily Contribution by Source Buffalo River
Nonpoint source loadings from pervious land segments	16%
Nonpoint source loadings from impervious land segments	<1%
Direct nonpoint source loadings to the stream from livestock	46%
Direct nonpoint source loadings to the stream from straight pipes	5%
Direct nonpoint source loadings to the stream from wildlife	32%
Interflow and groundwater contribution	<1%
Permitted point source loadings	<1%

3.5 Sediment Source Assessment

3.5.1 Stressor Analysis

TMDLs must be developed for a specific pollutant(s). Benthic assessments are very good at determining if a particular stream segment is impaired or not but they usually do not provide enough information to determine the cause(s) of the impairment. The process outlined in the Stressor Identification Guidance Document (USEPA 2000) was used to separately identify the most probable stressor(s) for Long Branch and Buffalo River. A list of candidate causes was developed from published literature and DEQ staff input. Chemical and physical monitoring data provided evidence to support or eliminate potential stressors. Individual metrics for the biological and habitat evaluation were used to determine if there were links to a specific stressor(s). Land use data as well as a visual assessment of conditions along the streams provided additional information to eliminate or support candidate stressors. This stressor analysis identified sediment as the Most Probable Stressor for aquatic life in Long Branch and Buffalo River.

3.5.2 Point Sources

There were two industrial stormwater general permits (ISWGP) discharging within the benthic impaired Buffalo River watershed (Table 3-7) at the time of TMDL development. There were no active land disturbing (construction stormwater) permits in either the Long Branch or Buffalo River watersheds at the time of TMDL development.

Table 3-7. Permitted industrial stormwater dischargers in the Buffalo River watershed.

Permit Number	Facility Name	Receiving Stream
VAR050404	EF Fitzgerald Lumber	South Fork Buffalo River, unnamed tributary
VAR050411	Ellington Wood Products Inc	Buffalo River, unnamed tributary

3.5.3 Nonpoint Sources

Nonpoint sources of sediment in the watersheds include runoff from residential areas, cropland, pasture, forest, and impervious areas. Erosion of the stream bank is another source of sediment in the watershed. The sediment process is a natural and continual process that is often accelerated by human activity. During runoff events (natural rainfall or irrigation), sediment is transported to streams from land areas (e.g., agricultural fields, lawns, forest, etc.). Rainfall energy, soil cover, soil characteristics, topography, and land management affect the magnitude of sediment loading. Agricultural management activities such as overgrazing (particularly on steep slopes), high tillage operations, livestock concentrations (along stream edge and uncontrolled access to streams), forest harvesting, and construction (roads, buildings, etc.) accelerate erosion at varying degrees. During dry periods, sediment from air or traffic builds up on impervious areas and is transported to streams during runoff events. The TMDL report identified the primary nonpoint source of sediment in Long Branch and Buffalo River as pastureland (Table 3-8).

Table 3-8. Estimated nonpoint source sediment loads for the benthic impaired Long Branch and Buffalo River watersheds by land use (VDEQ, 2013b).

Land Use/Source Group	Long Branch		Buffalo River	
	Land Area (acres)	Sediment Load (tons/yr)	Land Area (acres)	Sediment Load (tons/yr)
Row Crops	1.8	17.6	141.2	125.2
Pasture	217.3	760.6	1,824.5	4,344.6
Hay	65.3	71.9	455.3	308.6
Forest	1,192.5	108.8	17,810.7	1,781.7
Harvested Forest	12.0	8.6	178.9	141.5
Developed	36.3	25.2	945	663.5
Channel Erosion		0.9		134.4
Total Load		**993.6**		**7,499.5**

3.6 TMDL Allocation Scenarios

3.6.1 Bacteria

The bacteria TMDLs include reduction scenarios needed to meet the *E. coli* water quality standard. Different scenarios were evaluated to identify scenarios for implementation that meet the calendar-month geometric mean bacteria standard (126 cfu/100 mL for E. coli) with zero exceedances. The margin of safety (MOS) was implicitly incorporated into each TMDL by conservatively estimating several factors affecting bacteria loadings, such as animal numbers, production rates, and contributions to streams. Preferred scenarios were selected by a technical advisory committee during the TMDL development process (Table 3-9). The bacteria TMDLs for the Buffalo River watershed were derived from the preferred reduction scenarios identified in the TMDL report (Table 3-10). An implicit margin of safety is included in the TMDL equations.

Table 3-9. Bacteria reduction scenario needed to meet the *E. coli* water quality standard for the Buffalo River watershed.

Watershed	*E. coli* Loading Reductions (%)					% Exceedance of *E. coli* standard	
	Livestock Direct Deposit	Pasture	Cropland	Straight Pipes and Failing Septic Systems	Wildlife Direct Deposit	Geometric Mean Criterion	Single Sample Maximum Assessment Criterion*
Mill Creek	99%	20%	5%	100%	35%	0	4.9
Turner Creek	99%	30%	5%	100%	30%	0	3.2
Rutledge Creek	99%	10%	5%	100%	30%	0	2.7
Buffalo River	90%	5%	5%	100%	0%	0	4.9

* The single sample maximum assessment criterion allows up to 10.5 % exceedance rate.

Table 3-10. Bacteria TMDL equations for Buffalo River watershed expressed as an average annual and a maximum daily load.

Watershed	Wasteload Allocation (WLA)		Load Allocation (LA)		Margin of Safety (MOS)	TMDL	
	Annual (cfu/yr)	Daily (cfu/day)	Annual (cfu/yr)	Daily (cfu/day)		Annual (cfu/yr)	Daily (cfu/day)
Mill Creek	2.08×10^{11}	5.70×10^{8}	9.98×10^{12}	1.69×10^{11}	Implicit	1.02×10^{13}	1.70×10^{11}
Turner Creek	1.57×10^{11}	4.31×10^{8}	7.71×10^{12}	2.63×10^{11}	Implicit	7.87×10^{12}	2.63×10^{11}
Rutledge Creek	1.15×10^{12}	3.15×10^{9}	2.03×10^{13}	6.65×10^{11}	Implicit	2.15×10^{13}	6.68×10^{11}
Buffalo River	2.54×10^{12}	6.96×10^{8}	1.25×10^{14}	3.85×10^{12}	Implicit	1.27×10^{14}	3.86×10^{12}

Note that the TMDL goals cannot be met without bacteria reductions from wildlife sources. This IP focuses on reducing the anthropogenic bacteria sources to meet the delisting goal, that is, less than 10.5% exceedance of the single sample criterion (235 cfu/100 mL). The reductions needed to meet the delisting goals for each impaired segment were modeled during TMDL development (Table 3-11).

Table 3-11. Bacteria reduction scenario needed to meet the *E. coli* delisting goals for the Buffalo River watershed.

Watershed	*E. coli* Loading Reductions (%)				% Exceedance of *E. coli* standard	
	Livestock Direct Deposit	Pasture	Cropland	Straight Pipes and Failing Septic Systems	Geometric Mean Criterion	Single Sample Maximum Assessment Criterion*
Mill Creek	80%	20%	5%	100%	16.7	10.3
Turner Creek	65%	30%	5%	100%	16.7	10.3
Rutledge Creek	60%	10%	5%	100%	18.8	10.0
Buffalo River	10%	5%	5%	100%	14.6	8.6

* The single sample maximum assessment criterion allows up to 10.5 % exceedance rate.

3.6.2 Sediment

The Long Branch and Buffalo River benthic TMDLs were developed for sediment, with Fishpond Creek as the reference watershed. The target TMDL loads for the impaired stream segments are the average annual loads from the area-adjusted Fishpond Creek watershed under existing conditions. The sediment TMDLs for Long Branch and Buffalo River include three components – wasteload allocation (WLA), load allocation (LA), and margin of safety (MOS). The MOS was explicitly set to 10% to account for uncertainty in developing benthic TMDLs. The WLA was calculated as the sum of the permitted point source loads. The TMDL study anticipated that future development would be minimal. Therefore, future land use in the watersheds was represented at the existing conditions. The reductions identified in the TMDL report required to meet the TMDLs are shown in Table 3-12 and Table 3-13. The sediment TMDLs for the Buffalo River watershed are listed in Table 3-14.

Table 3-12. Long Branch sediment TMDL load allocation (LA) scenarios.

Land Use/Source Group	Land Area (acres)	Sediment Load (tons/yr)	Scenario 1		Scenario 2	
			% Reduction	Load (tons/yr)	% Reduction	Load (tons/yr)
Row Crops	1.8	17.6	59.8%	7.1		17.6
Pasture	217.3	760.6	59.8%	305.6	66.7%	253.3
Hay	65.3	71.9	59.8%	28.9		71.9
Forest	1,192.5	108.8		108.8		108.8
Harvested Forest	12.0	8.6	42.9%	4.9	42.9%	4.9
Developed	36.3	25.2	59.8%	10.1	66.7%	8.4
Channel Erosion		0.9	59.8%	0.4		0.9
Total Load		993.6		465.8		465.8

LA =	465.8	tons/yr
Needed Reduction =	527.8	tons/yr
% Reduction Needed =	53.1%	

Table 3-13. Buffalo River sediment TMDL load allocation (LA) scenarios.

Land Use/Source Group	Land Area (acres)	Sediment Load (tons/yr)	Scenario 1		Scenario 2	
			% Reduction	Load (tons/yr)	% Reduction	Load (tons/yr)
Row Crops	141.2	125.2	61.8%	47.8		125.2
Pasture	1,824.5	4,344.6	61.8%	1,660.0	68.8%	1,355.4
Hay	455.3	308.6	61.8%	117.9		308.6
Forest	17,810.7	1,781.7		1,781.7		1,781.7
Harvested Forest	178.9	141.5	42.9%	80.9	42.9%	80.9
Developed	945.0	663.5	61.8%	253.5	68.8%	207.0
Channel Erosion		134.4	61.8%	51.4		134.4
Total Load		7,499.5		3,993.1		3,993.2

LA =	3,993.2	tons/yr
Needed Reduction =	3,506.4	tons/yr
% Reduction Needed =	46.8%	

Table 3-14. Sediment TMDL equations for Buffalo River watershed expressed as an average annual and a maximum daily load.

Watershed	Wasteload Allocation (WLA)		Load Allocation (LA)		Margin of Safety (MOS)		TMDL	
	Annual (tons/yr)	Daily (tons/dy)	Annual (tons/yr)	Daily (tons/dy)	Annual (tons/yr)	Daily (tons/dy)	Annual (tons/yr)	Daily (tons/dy)
Long Branch	16.1	0.04	465.8	4.50	53.5	0.50	535.4	5.04
Buffalo River	342.0	0.93	3,993.2	39.14	481.7	4.45	4,816.9	44.52

3.7 Implications of the TMDL on the Implementation Plan

Based on the bacteria reductions developed for the TMDLs, it is clear that significant reductions will be needed to meet the water quality standard for bacteria, particularly with respect to direct deposition from livestock. In addition, all uncontrolled discharges, failing septic systems, leaking sewer lines, and overflows must be identified and corrected.

However, there are subtler implications as well. Implicit in the requirement for 100% correction of uncontrolled discharges is the need to maintain all functional septic systems. Wildlife bacteria loads will not be explicitly addressed by this implementation plan. All efforts will be directed at controlling anthropogenic sources.

Although the benthic TMDLs were developed for sediment, attainment of a healthy benthic community will ultimately be based on biological monitoring of the benthic macroinvertebrate community, in accordance with established DEQ protocols. If a future review should find that the reductions called for in these sediment TMDLs based on current modeling are found to be insufficiently protective of local water quality, then revision(s) will be made as necessary to provide reasonable assurance that water quality goals will be achieved.

3.8 Changes Since TMDL Study

3.8.1 Alternate Sediment Allocation Scenarios

During implementation planning, the recommended percent reductions from sediment sources in the allocation scenarios changed slightly from the TMDL study. The agricultural and residential working group selected reduction scenarios (Table 3-15 and Table 3-16) that parallel the reductions needed to meet the bacteria water quality goals and account for BMPs installed in the sediment impaired watersheds since TMDL development. The working group recommended that half of the reductions be applied during the first five years of implementation (Stage 1) and the remainder during the next five years (Stage 2).

3.8.2 Additional Impairments

Since completion of the TMDL studies, four additional segments in the Buffalo River watershed have been identified as impaired due to exceedances of the *E. coli* criteria. These are an upstream segment of Rutledge Creek, VAW-H12R_RTD03A14, and three segments of Buffalo River, VAW-H11R_BUF03B14, VAW-H12R_BUF02A02, and VAW-H12R_BUF01A00 (Table 3-1, Figure 3-1). These additional impairments are “nested” within the existing Rutledge Creek, Buffalo River, and Tye River TMDLs.

Table 3-15. Long Branch sediment TMDL load allocation (LA) scenario used for implementation.

Land Use/Source Group	Land Area (acres)	Sediment Load (tons/yr)	Implementation Scenario		Stage 1	Stage 2
			% Reduction	Load (tons/yr)	% Reduction	% Reduction
Row Crops	1.8	17.6		17.6		
Pasture	217.3	760.6	69.0%	235.8	34. 50%	34. 50%
Hay	65.3	71.9		71.9		
Forest	1,192.5	108.8		108.8		
Harvested Forest	12.0	8.6	42.9%	4.9	21.45%	21.45%
Developed	36.3	25.2		25.2		
Channel Erosion		0.9		0.9		
Total Load		993.6		465.1		

LA =	465.8	tons/yr
Needed Reduction =	527.8	tons/yr
% Reduction Needed =	53.1%	

Table 3-16. Buffalo River sediment TMDL load allocation (LA) scenario used for implementation.

Land Use/Source Group	Land Area (acres)	Sediment Load (tons/yr)	Implementation Scenario		Stage 1	Stage 2
			% Reduction	Load (tons/yr)	% Reduction	% Reduction
Row Crops	141.2	125.2	15%	106.4	7.5%	7.5%
Pasture	1,824.5	4,344.6	78.9%	916.7	39.45%	39.45%
Hay	455.3	308.6		308.6		
Forest	17,810.7	1,781.7		1,781.7		
Harvested Forest	178.9	141.5	42.9%	80.9	21.45%	21.45%
Developed	945.0	663.5		663.5		
Channel Erosion		134.4		134.4		
Total Load		7,499.5		3,992.2		

LA =	3,993.2	tons/yr
Needed Reduction =	3,506.4	tons/yr
% Reduction Needed =	46.8%	

4. PUBLIC PARTICIPATION

Collecting input from the public on implementation and outreach strategies to include in the TMDL Implementation Plan was a critical step in this planning process. Since the plan will be implemented voluntarily by watershed stakeholders, local input and support are the primary factors that will determine the success of this plan.

4.1 Public Meetings

A public meeting was held on the evening of October 8, 2019 at the Amherst County Administration Building in Amherst to kick off the development of the implementation plan. This meeting served as an opportunity for local residents to learn more about the problems facing the Buffalo River and work together to come up with new ideas to protect and restore water quality in their community. This meeting was publicized through a public notice, community websites, and direct e-mail communications with the Central Virginia Planning District Commission (PDC), Robert E. Lee SWCD, USDA NRCS, Town of Amherst, and Amherst County. Approximately 16 people attended the meeting.

The meeting included a presentation by DEQ on the process to be used to complete a TMDL IP for Buffalo River. The presentation also included a discussion on existing water quality conditions in the river and what types of actions and information could be included in the implementation plan to improve water quality.

A virtual final public meeting was held on October 20, 2020. Five people attended.

4.2 Working Groups

The role of the IP working groups was to discuss methods needed to reduce bacteria and sediment sources from entering the Buffalo River watershed. For residential bacteria sources, the residential working group’s goal was to recommend methods to identify and correct or replace failing septic systems and straight pipes. For livestock sources, the agricultural working group’s aim was to review BMP practices and outreach strategies from an agricultural perspective. Overall, the working groups objectives were to provide input about the type, number, and costs of BMPs and to identify any barriers (and possible solutions) that could impede BMP implementation.

During their first meetings on December 10, 2019, the working groups discussed timeframes needed to meet implementation goals. The groups agreed that implementation should occur in two 5-year stages. Each of the groups also discussed education and outreach opportunities in the watershed. Attendees of the government working group meeting consisted of staff from the Town of Amherst, Amherst County, Virginia Department of Health, and the Natural Resource Conservation Service, among others. They discussed residential sewage handling and disposal, including percentages of failing septic systems needing repairs or replacements. They also discussed available agricultural programs for implementation, current level of participation, and funding opportunities. On-site sewage disposal was one of the topics the residential working group discussed, including ways to inform residents of the watershed of potential funding available to assist in the repair or replacement of failing septic systems. The agricultural working group consisted of various members of the community, including Robert E. Lee Soil and Water Conservation staff. They discussed agricultural practices such as stream fencing and improved grazing management, and barriers to implementation.

A second agricultural and residential working group meeting was held on February 17, 2020 at the Amherst County Administration Building to review preliminary best management practices and associated estimated costs. The group requested that 60% of the residential practices (repair and replacement of failing septic systems and straight pipes) be implemented in the first five years (Stage 1) and with the remainder the next five years (Stage 2). The group requested that 50% of the agricultural practices be implemented in Stage 1 and the remainder in Stage 2.

4.3 Steering Committee

The Steering Committee received a draft implementation plan in May 2020. The group had the opportunity to provide comments on the draft plan prior to the final public meeting on October 20, 2020.

5. IMPLEMENTATION ACTIONS

An important part of the implementation plan is the identification of specific BMPs and the associated technical assistance needed to improve water quality. Since this IP is designed to be implemented by landowners on a voluntary basis, it is necessary to identify BMPs that are both financially and technically realistic and suitable for the community. As part of this process, the costs and benefits of the proposed BMPs must be evaluated. Once the suitable BMPs have been identified, the number of each BMP needed to meet the TMDLs and interim implementation goals is estimated.

5.1 Identification of Best Management Practices

Potential pollutant control measures or BMPs, their associated costs and efficiencies, and potential funding sources were identified through review of the TMDL, input from the working group, and literature reviews. BMPs that can be promoted through existing state and federal cost-share programs were identified, as well as those that are not currently supported by existing programs. Some BMPs had to be included in order to meet the water quality goals (e.g. repair or replacement of failing septic systems and straight pipes) established in the TMDL, while others were selected through a process of stakeholder review and analysis of their effectiveness in these watersheds.

5.1.1 Control Measures Implied by the TMDL

The reductions in bacteria identified by the bacteria TMDL study dictated that some BMPs must be employed during implementation in order to meet the pollutant reductions specified in the bacteria TMDLs.

Livestock Exclusion

In order to meet the bacteria reductions in direct deposition from livestock, some form of stream exclusion is necessary. Fencing is the most obvious choice; however, the type of fencing, distance from the stream bank, and most appropriate management strategy for the fenced pasture are less obvious. While it is recognized that farmers will want to minimize the cost of fencing and the amount of pasture lost, the inclusion of a streamside buffer strip helps to reduce bacteria, sediment and nutrient loads in runoff. The incorporation of effective buffers (35-foot minimum width) could reduce the need for more costly control measures. From an environmental perspective, the best management scenario would be to exclude livestock from the stream bank 100% of the time and establish permanent vegetation in the buffer area. This prevents livestock from eroding the stream bank, provides a buffer for capturing pollutants in runoff from the pasture, and establishes (with the growth of streamside vegetation) one of the foundations for healthy aquatic life. From a livestock-production perspective, the best management scenario is one that provides the greatest profit to the farmer. Taking even a small amount of land out of production may seem contrary to that goal. However, a clean water source has been shown to improve milk production and weight gain. Clean water will also improve the health of animals (*e.g.,* cattle and horses) by decreasing the incidence of waterborne illnesses and exposure to swampy areas near streams. State and federal conservation agencies including Virginia Department of Conservation and Recreation (VADCR) and the Natural Resources Conservation Service (NRCS) have incorporated livestock exclusion practices into their agricultural cost-share programs that offer farmers greater flexibility in fencing options and greater financial incentives. This flexibility allows farmers with limited pasture acreage to exclude livestock from the stream while reducing the amount of grazing land that is taken out of production.

Septic Systems and Straight Pipes

The 100% reduction in loads from failing septic systems and straight pipes is required by law. The options identified for addressing straight pipes and failing septic systems included: maintenance or repair of an existing septic system, installation/replacement of a conventional septic system, installation of an alternative waste treatment system, and connection to an existing permitted waste treatment system. It is anticipated that a significant portion of straight pipes will be located in areas where adequate space for a conventional septic drain field is not available. In these cases, the landowner will have to consider an alternative septic system.

5.1.2 Control Measures Selected through Stakeholder Review

In addition to the BMPs that were required by the bacteria TMDLs, a number of others were needed to control fecal bacteria and sediment from land-based (nonpoint) sources. Various alternative BMP implementation scenarios (number and type) were developed and presented to the working group. All scenarios began with the BMPs that were prescribed by the bacteria TMDLs, such as eliminating all straight pipes. Next, a series of established BMPs were examined by the working group, who considered both their economic costs and the water quality benefits that they produced. The majority of these practices are included in state and federal cost-share programs that promote conservation. In addition, innovative and site-specific practices suggested by local stakeholders and technical conservation staff were considered.

The initial set of BMPs and their efficiencies considered to estimate needs for this plan are listed in Table 5-1.

5.2 Quantification of Control Measures

The quantity of control measures recommended during IP development was determined through spatial analyses, modeling alternative implementation scenarios, and using input from the working groups. Data on land use, stream networks, and elevation were used in spatial analyses to develop estimates of the number of control measures recommended overall in the watershed, and within smaller sub-watersheds. For implementation planning purposes, the Buffalo River watershed is divided into seven sub-watersheds (Figure 5-1, Table 5-2).

Table 5-1. Best management practices and associated pollutant reductions.

BMP	% Effectiveness		Reference	Units
	Sediment	Bacteria		
Livestock Exclusion Practices				
CREP Stream Exclusion with Grazing Land Management (CRSL-6)	40%	100%	1	system
Stream Exclusion with Narrow Width Buffer and Grazing Land Management (SL-6N)	40%	100%	1	system
Stream Exclusion with Wide Width Buffer and Grazing Land Management (SL-6W)	40%	100%	1	system
Stream Protection (WP-2N, WP-2W, WP-2T)	40%	100%	1	system
Pasture Practices				
Improved Pasture Management (SL-7, SL-10)	30%	50%	1	acres
Permanent Vegetative Cover on Critical Areas (SL-11)	75%	75%	1	acres
Afforestation of Erodible Pasture (FR-1)	Land Use Change	Land Use Change	1	acres
Small Acreage Grazing System – Equine (SL-6AT)	40%	40%	1	acres
Water Control Structures (WP-1)	49%	88%	1	acres treated
Cropland Practices				
Long Term Vegetative Cover on Cropland (SL-1)	75%	75%	1	acres
Cover Crop (SL-8B, SL-8H)	20%	20%	1	acres
Residential Wastewater Practices				
Septic Tank Pump-out (RB-1)	N/A	5%	1	system
Connection to Public Sewer (RB-2)	N/A	100%	1	system
Septic Tank System Repair, Inspection and Maintenance (RB-3, RB-3R)	N/A	100%	1	system
Septic Tank System Installation/Replacement (RB-4, RB-4P)	N/A	100%	1	system
Alternative On-site Waste Treatment System (RB-5)	N/A	100%	1	system
Forest Harvesting Practices				
Forest Harvesting BMPs	60%	N/A	2	acres treated

1 - VDEQ. 2017. Guidance Manual for Total Maximum Daily Load Implementation Plans
2 - Chesapeake Assessment Scenario Tool (accessed 2/28/2020)

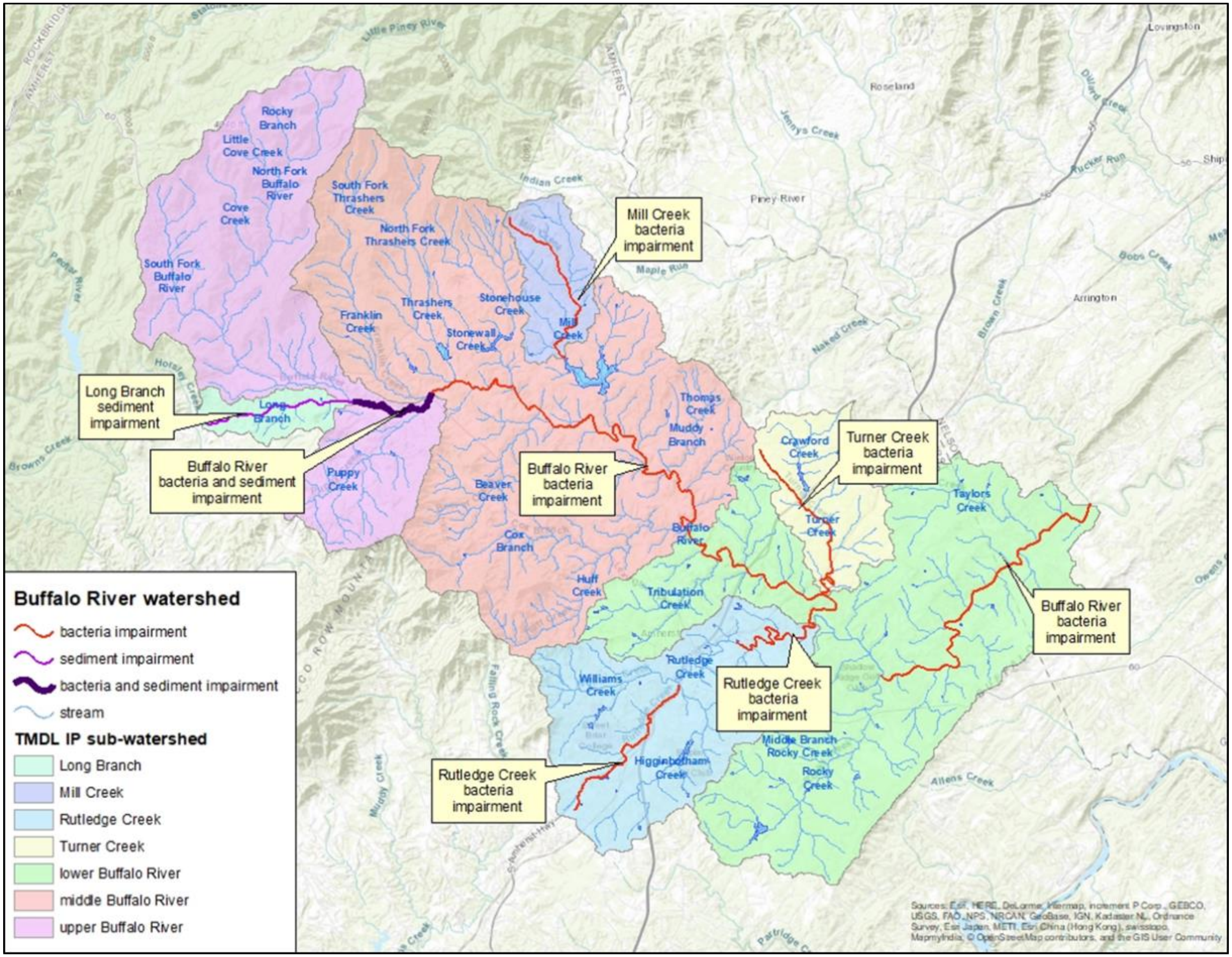

Figure 5-1. Buffalo River sub-watersheds and impaired segments.

Table 5-2. Buffalo River sub-watersheds and impaired segments addressed in the IP.

Sub-watershed	Upstream endpoint	Downstream endpoint	includes	does not include
upper Buffalo River	headwaters of North Fork and South Fork Buffalo River	confluence with Franklin Creek	North Fork Buffalo River, South Fork Buffalo River, Puppy Creek	Long Branch, Franklin Creek
Long Branch	headwaters	confluence with Buffalo River	–	–
middle Buffalo River	confluence with Franklin Creek	confluence with Huff Creek	Franklin Creek, Thrashers Creek, Stonehouse Creek, Beaver Creek, Mill Creek downstream from and including Mill Creek Lake, Huff Creek	Mill Creek upstream from Mill Creek Lake
Mill Creek	headwaters	Mill Creek Lake	–	Mill Creek Lake
Turner Creek	headwaters	confluence with Buffalo River	–	–
Rutledge Creek	headwaters	confluence with Buffalo River	–	–
lower Buffalo River	confluence with Huff Creek	confluence with Tye River	Tribulation Creek, Rocky Creek, Taylors Creek	Huff Creek, Turner Creek, Rutledge Creek

Data from the Virginia Department of Conservation and Recreation (VADCR) Agricultural BMP Database and the Robert E. Lee SWCD showing where BMPs are already installed were considered when developing the agricultural BMP estimates (Table 5-3). In addition, census data were used to quantify septic system repairs and replacements needed to meet the reductions specified in the bacteria TMDLs. Estimates of the number of residential on-site waste treatment systems, streamside fencing and number of full livestock exclusion systems were made through these analyses. The number of additional BMPs were determined through modeling alternative scenarios and applying the related pollutant reduction efficiencies to the associated bacteria and sediment loads.

Table 5-3. Agricultural best management practices (BMPs) installed in the Buffalo River watershed between TMDL development and June 2019.

Sub-watershed	BMP Name	BMP Code	Extent Installed		
			Number	Units	Amount
Mill Creek	Long term vegetative cover on cropland	SL-1	1	acres	8.4
Rutledge Creek	Stream exclusion with grazing land management	SL-6	1	linear feet	4,300
Turner Creek	Stream exclusion with grazing land management	SL-6	1	linear feet	600
upper Buffalo River	Stream exclusion with grazing land management	SL-6	1	linear feet	2,422
	Small grain and mixed cover crop	SL-8B	3	acres	252.6
middle Buffalo River	Stream exclusion with grazing land management	SL-6	7	linear feet	27,848
	Small grain and mixed cover crop	SL-8B	1	acres	109
lower Buffalo River	Stream exclusion – maintenance practice	CCI-SE-1	2	linear feet	10,397
	Livestock exclusion with reduced setback	LE-2	2	linear feet	1,395.5
	Stream exclusion with grazing land management	SL-6	2	linear feet	3,274.5

5.2.1 Agricultural Control Measures

Livestock Exclusion BMPs

In order to reduce bacteria and sediment in Buffalo River and its tributaries, livestock must be excluded from the stream. To estimate fencing needs, the stream network was overlaid with land use using GIS mapping software. Stream segments that flowed through or were adjacent to land use areas that had a potential for supporting cattle (e.g., pasture) were identified using 2016 Virginia Land Cover Dataset (VLCD), which is derived from aerial imagery, and the 2017 National Hydrography Dataset (NHD) streams layer. If the stream segment flowed through the land-use area, it was assumed that fencing was needed on both sides of the stream. If a stream segment flowed adjacent to the land-use area, it was assumed that fencing was required on only one side of the stream. Not every land-use area identified as pasture has livestock on it at any given point in time. However, it is assumed that all pasture areas have the potential for livestock access. Following GIS analyses of fencing needs, the VADCR Agricultural BMP Database was queried to identify the number of livestock exclusion systems already in place in the watershed. Approximately 40,000 linear feet of livestock exclusion fencing has been installed in the Buffalo River watershed since the TMDL studies. This fencing was subtracted from the length of fencing needed to accomplish the reduction of bacteria and sediment loads from livestock stream access needed to meet the delisting goals (Table 5-4) for a total of approximately 21.8 miles of exclusion fencing still needed.

Table 5-4. Stream fencing needs summary.
Note: % of total shown in parenthesis.

Sub-watershed	Estimated total length of streambank in pasture (feet)	% reduction of livestock in stream	Approximate fencing installed to date** (feet)	Fencing still needed	
				Stage 1 (feet)	Stage 2 (feet)
upper Buffalo River	79,686	95*	2,422	36,640	36,640
Long Branch	14,159	80*	0	5,664	5,663
middle Buffalo River	184,748	10	27,848	0	0
Mill Creek	28,353	80	0	11,341	11,341
Turner Creek	11,537	65	600	3,450	3,449
Rutledge Creek	8,645	60	4,300	887	0
lower Buffalo River	20,022	10	4,670	0	0
Total	**347,150**		**39,840**	**57,982**	**57,093**

* Reduction needed to meet sediment TMDL goal.
** Since TMDL development.

It is expected that the majority of livestock exclusion fencing will be accomplished through Virginia Agricultural BMP Cost-Share Program (VACS), DEQ Non-Point Source BMP Implementation Program, and federal Natural Resource Conservation Service (NRCS) cost-share programs. Landowners have a number of options when it comes to installing livestock exclusion fencing through these programs. Some applicable cost-shared BMPs for livestock exclusion in the programs are the SL-6N (Stream Exclusion with Narrow Width Buffer and Grazing Land Management), the SL-6W (Stream Exclusion with Wide Width Buffer and Grazing Land Management), and CREP (Conservation Reserve Enhancement Program) practice CRSL-6 (CREP Stream Exclusion with Grazing Land Management).

In order to develop an estimate of the number of fencing systems needed in the watershed, aerial imagery was utilized in conjunction with local data from the VADCR Agricultural BMP Database to determine typical characteristics (e.g., streamside fencing length per practice) of livestock exclusion systems in the region. In addition, input was collected from the working group and the Robert E. Lee SWCD regarding typical components of each system, associated costs, and preferred fencing setbacks. These characteristics were then utilized to identify the mix of fencing practices available through state and federal cost-share programs to include in the implementation plan (Table 5-5).

Table 5-5. Livestock exclusion needed to achieve reduction of bacteria sediment load from livestock direct deposition.
Assumes one exclusion system averages 2,200 linear feet of stream fencing.

Sub-watershed	Fencing needed	SL-6N (10 – 25 ft buffer): 70%		SL-6W (35 – 50 ft buffer): 25%		CRSL-6 (100 ft buffer): 5%	
	feet	feet	systems	feet	systems	feet	systems
Stage 1							
upper Buffalo River	36,640	25,648	11	9,160	4	1,832	1
Long Branch	5,664	3,965	2	1,699	1	0	0
middle Buffalo River	0	0	0	0	0	0	0
Mill Creek	11,341	7,939	3	2,835	1	567	1
Turner Creek	3,450	2,415	1	1,035	1	0	0
Rutledge Creek	887	887	1	0	0	0	0
lower Buffalo River	0	0	0	0	0	0	0
Total Stage 1	57,982	40,854	18	14,729	7	2,399	2
Stage 2							
upper Buffalo River	36,640	25,648	11	9,160	4	1,832	1
Long Branch	5,663	3,964	2	1,699	1	0	0
middle Buffalo River	0	0	0	0	0	0	0
Mill Creek	11,341	7,939	3	2,835	1	567	1
Turner Creek	3,449	2,414	1	1,035	1	0	0
Rutledge Creek	0	0	0	0	0	0	0
lower Buffalo River	0	0	0	0	0	0	0
Total Stage 2	57,093	39,965	17	14,729	7	2,399	2
Total	**115,075**	**80,819**	**35**	**29,458**	**14**	**4,798**	**4**

The VACS Program includes a series of livestock exclusion practices that may be used to meet exclusion goals in priority implementation watersheds. Stream Exclusion with Narrow Width Buffer and Grazing Land Management (SL-6N) offers between 60% to 75% cost-share rate for off stream watering, establishment of a rotational grazing system, stream crossings, and stream exclusion fencing with a 10 to 25-foot setback and a lifespan of 10 to 15 years. Based on discussions with the working group, it was determined that the practices with narrow buffer width would be the most appealing to producers in the watershed due to the minimal buffer setback requirement. Greater buffer setbacks were discussed, but working group members felt that even with additional financial incentives, a setback greater than 25 feet would be less achievable. It was estimated that approximately 70% of fencing in the watershed would be installed using the SL-6N practice.

For areas where greater setbacks would be possible, the Stream Exclusion with Wide Width Buffer and Grazing Land Management (SL-6W) offers between 85% to 100% cost-share rate for off stream watering, establishment of a rotational grazing system, stream crossings, and stream exclusion fencing with a 35 to 50-foot setback and a lifespan of 10 to 15 years. It was estimated that approximately 25% of fencing in the watershed would be installed using the SL-6W practice.

Another option is the CREP Stream Exclusion with Grazing and Land Management (CRSL-6). The CRSL-6 practice is implemented under CREP. It offers up to 35% cost-share rate over a lifespan of 10 to 15 years. It is similar to the SL-6W practice with a minimum 35-foot riparian buffer. It was estimated that approximately 5% of fencing in the watershed would be installed using the CRSL-6 practice.

While the suite of BMPs outlined in this plan will satisfy the bacteria and sediment reductions needed to meet water quality goals, the quantity and details of these BMPs are subject to change in the future to reflect updates to related policies and programs, including cost share programs.

Land Based Agricultural BMPs

In order to meet the bacteria and sediment reductions outlined in the TMDLs, BMPs to treat land-based sources of bacteria and sediment must also be included in implementation efforts. Table 5-6 provides a summary of land based agricultural BMPs by watershed needed to achieve water quality goals. It is expected that funding assistance for the majority of agricultural practices will be provided by the Virginia Agricultural BMP Cost-Share Program (VACS), DEQ Non-Point Source BMP Implementation Program, and federal Natural Resource Conservation Service (NRCS) cost-share programs.

Afforestation of Erodible Pasture (FR-1)

A small portion of pastureland is designated for tree planting. This practice will be performed on pasture that is not well suited for agriculture due to slope and other characteristics. The intent of including this practice is not to reduce the presence of agriculture in the watershed, but rather to optimize the use of suitable pastureland in the watershed and prevent runoff and soil loss from marginal agricultural lands. Cost-share funding is available for tree planting, and a flat rate payment per acre is also made through this practice depending on the length of the BMP contract.

Permanent Vegetation on Critical Areas (SL-11)

This practice supports land shaping and planting permanent vegetative cover on critically eroding areas. This may include measures such as grading, shaping, and filling, the establishment of grasses, and trees or shrubs. Landowners may receive up to 75% cost share for this practice and must maintain the practice for a period of five years. This practice is particularly applicable in highly denuded areas where concentrated runoff of manure is occurring.

Table 5-6. Estimated agricultural land and potential agricultural BMPs to accomplish bacteria and sediment reduction goals in the Buffalo River watershed.

BMP	Sub-watershed	Existing (acres)	Extent needed (% total land use acres)	Extent needed (acres)
Pasture				
Improved Pasture Management (SL-10)	Mill Creek	824	36%	297
	Rutledge Creek	1,317	19%	250
	Turner Creek	758	48%	364
	Long Branch	217	55%	119
	upper Buffalo River	1,825	88%	1,588
	middle Buffalo River	3,276	9%	295
	lower Buffalo River	2,423	9%	218
Afforestation of Erodible Pasture (FR-1)	upper Buffalo River	1,825	1.2%	22
Permanent Vegetative Cover on Critical Areas (SL-11)	upper Buffalo River	1,825	0.1%	2
Cropland				
Cover Crop (SL-8B, SL-8H)	Mill Creek	448	24%	108
	Rutledge Creek	973	25%	243
	Turner Creek	609	25%	152

Grazing Systems and Improved Pasture Management (SL-7, SL-10)

Establishment of rotational grazing systems for cattle is recommended in conjunction with livestock exclusion projects. The majority of fencing programs will provide cost-share for the establishment of cross fencing and alternative watering sources in order to establish these systems. In cases where livestock exclusion is not necessary, improved pasture management was prescribed. Like a grazing system, improved pasture management allows a farmer to better utilize grazing land and associated forage production. Improved pasture management includes:

- Implementing a current nutrient management plan
- Maintaining adequate soil nutrient and pH levels
- Managing livestock rotation to paddock subdivisions to maintain minimum grazing height recommendations and sufficient rest periods for plant recovery
- Maintaining adequate and uniform plant cover (≥ 60%) and pasture stand density
- Locating feeding and watering facilities away from sensitive areas
- Managing distribution of nutrients and minimizing soil disturbance at hay feeding sites by unrolling hay across the upland landscape in varied locations
- Designating a sacrifice lot/paddock to locate cattle for feeding when adequate forage is not available in the pasture system. Sacrifice lot/paddock should not drain directly into ponds, creeks or other sensitive areas and should not be more than 10% of the total pasture acreage.

- Chain harrowing pastures to break-up manure piles after livestock are removed from a field at least twice a year to uniformly spread the manure load, or manage manure distribution through rotational grazing

Cover Crop (SL-8B, SL-8H)

Farmers are implementing the use of cover crops because of the benefits associated with improved soil quality, reduction of nutrient losses, decreased field maintenance, and erosion control. Cost-share funding and/or tax credit are available for cover crop practices.

5.2.2 Residential Control Measures

Failing Septic Systems and Straight Pipes

By law, all failing septic systems and straight pipes must be identified and corrected. The number of failing septic systems and straight pipes in the Buffalo River watershed was estimated based on the 2010 Census of Population and Housing for Virginia, as well as input from stakeholders during TMDL development. The 2010 U.S. Census block maps were used to estimate the spatial distribution of the failing septic systems and straight pipes. Table 5-7 shows the estimated number of failing septic systems and straight pipes in the Buffalo River watershed and the breakdown of the estimated septic system repairs and replacements. Residential cost share assistance is made available for these septic BMPs through the Virginia Nonpoint Source Implementation Program administered by DEQ. The geographical extent of an eligible area is identified in a grant agreement and in a watershed management plan such as a TMDL implementation plan. The residential septic BMPs outreach and funding will be most effective in cooperation with the local health department to make property owners with septic system malfunctions or straight pipes aware that funding is available locally.

Based on input from the working group, it was estimated that 98% of failing septic systems could be corrected with a repair or maintenance, and the remaining 2% would need to be replaced. DEQ administers cost-share assistance funding for targeted watersheds with approved implementation plans. These funds provide cost-share for septic system repairs, requiring a permit, and the inspection and maintenance of a septic systems that does not require a permit. It was estimated that half of the failing septic systems (not replaced) would be minor in nature and thus not require a permit, while the remainder would be significant enough that one would be required. Of the systems that need to be replaced, it was estimated that 2% will require alternative waste treatment systems due to the geology present at the site, or a lack of space necessary for a conventional septic drain field.

A septic tank pump-out program was also discussed by the working group as a good way to heighten local awareness of septic system maintenance needs and to locate failing septic systems. The estimates shown in Table 5-7 are based on pumping out septic tanks for 75% of households in the watershed.

Table 5-7. Estimated number of failing septic system and straight pipe repairs and replacements needed in the Buffalo River watershed.

Sub-watershed	Estimated Number of							
	Houses with				Septic System Pump-outs	Septic System Repairs	Conventional Septic Systems	Alternative Septic Systems
	Sewer Connection	Standard Septic Systems	Failing Septic Systems	Straight Pipes				
Mill Creek	0	79	14	1	58	14	0	1
Rutledge Creek	400	801	150	2	600	146	4	2
Turner Creek	0	331	63	1	247	62	1	1
Long Branch	0	12	2	1	9	2	0	1
upper Buffalo River	0	93	16	2	69	16	0	2
middle Buffalo River	0	580	120	0	435	117	3	0
lower Buffalo River	278	930	160	0	692	157	3	0
Total	**678**	**2,826**	**525**	**7**	**2,110**	**514**	**11**	**7**

5.2.3 Forestry Control Measures

Forest Harvesting

The main source of sediment on forested lands in the benthic impaired Long Branch and upper Buffalo River is commercial forest harvesting operations. In Virginia, loggers are required to protect water quality, and the Virginia Department of Forestry (VADOF) developed BMPs as guidelines for proper timber harvesting. To ensure voluntary compliance with these guidelines, the VADOF began conducting Best Management Practice Field Audits in 1993. Conducted four times a year, the field audits provide a useful tool in gaging the status of Virginia's water quality protection efforts. If loggers do not follow "best management practices" on harvest sites, sediment deposition may occur, and that can cause them to face civil penalties under the Silvicultural Water Quality Law. The forest harvesting BMP is a system of integrated conservation practices that are designed to prevent off-site sediment impact, protect stream crossings, and neutralize storm water runoff. During development of the sediment TMDLs for Long Branch and the upper Buffalo River, these BMPs were represented as being partially effective (30%) to model the sediment load from harvested forest land. Additional harvested forest BMPs such as vegetative establishment, water bars (diversion) and putting down gravel on steeper slopes on haul roads are recommended to reduce the loss of sediment from disturbed forest areas (Table 5-8).

Table 5-8. Estimated forest land and potential harvested forest BMPS to accomplish sediment goals in the upper Buffalo River watershed.

BMP	Sub-watershed	Existing (acres)	Extent needed (% total land use acres)	Extent needed (acres)
Forest				
Harvested Forest BMPs	Long Branch	1,204	1%	12
	upper Buffalo River	17,990	1%	179

5.1 Technical Assistance and Education

In order to get landowners involved in implementation, it will be necessary to initiate education and outreach strategies and provide technical assistance with the design and installation of various best management practices. There must be a proactive approach to contact farmers and residents to articulate exactly what the TMDL means to them and what practices will help meet the goal of improved water quality. The working groups recommended several education/outreach techniques, which will be utilized during implementation.

The following general tasks associated with agricultural and residential programs were identified:

Agricultural Programs

- Contact landowners in the watersheds to make them aware of cost-share assistance, and voluntary options that are available to agricultural producers interested in conservation.
- Provide technical assistance for agricultural programs (e.g., survey, design, layout).

- Give presentations at meetings of local Farm Bureau, Ruritans, and other groups. Provide information for distribution with newsletters and at local events (e.g., Amherst County Fair).
- Organize educational programs for farmers including farm tours in partnership with Robert E. Lee SWCD, NRCS, VA Cooperative Extension and Farm Bureau.
- Work with NRCS and Robert E. Lee SWCD to conduct door to door outreach regarding agricultural BMPs
- Work with VA Cooperative Extension to hold rotational grazing workshops and "fencing school" programs in the watersheds. These have been offered in other areas in the state and have been well received by the agricultural community.
- Work with county Board of Supervisors representatives to contact agricultural landowners in the watershed to discuss water quality issues and potential management strategies
- Assess and track progress toward BMP implementation goals
- Evaluate use of existing agricultural programs and suggest modifications; i.e. adaptive management

Residential Programs

- Identify failing septic systems (*e.g.*, contact landowners in older homes, septic pump-out program)
- Develop and distribute educational materials (e.g., septic system maintenance guide). Emphasize how the residential septic cost-share assistance can help reduce costs to the homeowner
- Create informational brochures for septic systems contractors and plumbers to distribute to customers
- Encourage a partnership between the Department of Health and local realtors to share the capacity of a home's septic system with potential buyers
- Conduct outreach at public service board meetings
- Launch a newspaper campaign about septic system maintenance. Emphasize the connection between proper maintenance, groundwater science and financial assistance available
- Utilize educational programs already established within the local schools
- Assess progress toward implementation goals

A critical component in the successful implementation of this plan is the availability of knowledgeable staff to work with landowners on implementing BMPs. While this plan provides a general list of practices that can be implemented in the watershed, property owners face unique management challenges including both design challenges and financial barriers to implementation of practices. Consequently, technical assistance from trained, local conservation professionals is a key component to successful BMP implementation. Technical assistance includes helping landowners identify suitable BMPs for their property, designing BMPs and locating funding to finance implementation.

The staffing level needed to implement the agricultural and residential components of the plan was estimated based on discussions with stakeholders and the staffing levels used in similar projects. Staffing needs were quantified using full time equivalents (FTE), with one FTE being equal to one full-time staff member. Based on the size of the watershed, the extent of implementation needed, and the overall project timeline, an estimate of one FTE was used for technical assistance. This estimate was based on similar implementation projects in other watersheds where one staff member is administering both the septic and agricultural programs. It is expected that staff from the Amherst County Health Department would be directly involved in any connections to septic system repair or replacement BMPs, serving as the project lead on any of these efforts in their locality with support from the Robert E. Lee SWCD.

6. COSTS AND BENEFITS

6.1 BMP Cost Analysis

The costs of agricultural best management practices included in the implementation plan were estimated based on data for Amherst County from the VADCR Agricultural BMP Database, the Robert E. Lee SWCD 2020 Program Year Average Annual Cost List for BMP components, and considerable input from the Robert E. Lee SWCD and working group.

The total cost of livestock exclusion systems includes not only the costs associated with fence installation, repair, and maintenance, but also the cost of developing alternative water sources for SL-6N, SL-6W, and CRSL-6. The cost of fence maintenance can often be a deterrent to participation. In developing the cost estimates for fence maintenance shown in Table 6-1, a figure of $3.25/linear foot of fence was used. It was estimated that approximately 10% of fencing would need to be replaced over the 10-year timeline of this project.

The majority of agricultural practices recommended in the IP are included in state and federal cost-share programs. These programs offer financial assistance in implementing the practices and may also provide landowners with an incentive payment to encourage participation. Consequently, both the potential cost to landowners and the cost to state and federal programs must be considered. Table 6-1 shows total agricultural BMP costs by watershed.

Residential areas contribute a small percentage (less than ten percent) of overall bacteria to the Buffalo River watershed. However, 100% of failing septic systems and straight pipes have to be repaired or replaced. The estimated costs of recommended residential BMPs were approximated based on input from the working group, other implementation plans in the vicinity, and Virginia’s NPS Implementation BMP Guidelines for Fiscal Year 2020. Table 6-2 shows total residential BMP costs for the implementation period.

Forest BMPs are needed to reduce the sediment loads in Long Branch and the upper Buffalo River. The estimated costs of recommended forest BMPs were approximated based on other implementation plans in the vicinity. Table 6-3 shows total forest BMP costs for the implementation period.

Total estimated costs for implementation practices needed to meet the bacteria and sediment delisting goals are summarized in Table 6-4 for the two planned stages of implementation. These stages and the associated timeline are explained in greater detail in Chapter 7.

Table 6-1. Agricultural BMP implementation costs for the Buffalo River watershed.
Assumes one exclusion system averages 2200 linear feet of stream fencing.

Practice	Unit	Average Unit Cost ($)	upper Buffalo River		Long Branch		middle Buffalo River		Mill Creek		
			Units	Cost	Units	Cost	Units	Cost	Units	Cost	
Stream Exclusion with Narrow Width Buffer and Grazing Land Management (SL-6N)	system	34,000	22	748,000	4	136,000	0	0	6	204,000	Continued
Stream Exclusion with Wide Width Buffer and Grazing Land Management (SL-6W)	system	34,000	8	272,000	2	68,000	0	0	2	68,000	
CREP Stream Exclusion with Grazing Land Management (CRSL-6)	system	33,000	2	66,000	0	0	0	0	2	66,000	
Exclusion Fence Maintenance (10 yrs)	feet	3.25	7,328	23,816	1,133	3,681	0	0	2,268	7,372	
Improved Pasture Management (SL-10)	acre	300	1,588	476,400	119	35,700	295	88,500	297	89,100	
Critical Area Stabilization (SL-11)	acre	2,500	2	5,000	0	0	0	0	0	0	
Afforestation of Erodible Pasture (FR-1)	acre	200	22	4,400	0	0	0	0	0	0	
Cover Crop (SL-8B, SL-8H)	acre	50	0	0	0	0	0	0	108	5,400	
Total Estimated Agricultural Cost by watershed				**$1,595,616**		**$243,381**		**$88,500**		**$439,872**	

Table 6-1. Agricultural BMP implementation costs for the Buffalo River watershed (continued).
Assumes one exclusion system averages 2200 linear feet of stream fencing.

Practice	Unit	Average Unit Cost ($)	Turner Creek		Rutledge Creek		lower Buffalo River		Total	
			Units	Cost	Units	Cost	Units	Cost	Units	Cost
Stream Exclusion with Narrow Width Buffer and Grazing Land Management (SL-6N)	system	34,000	2	68,000	1	34,000	0	0	35	1,190,000
Stream Exclusion with Wide Width Buffer and Grazing Land Management (SL-6W)	system	34,000	2	68,000	0	0	0	0	14	476,000
CREP Stream Exclusion with Grazing Land Management (CRSL-6)	system	33,000	0	0	0	0	0	0	4	132,000
Exclusion Fence Maintenance (10 yrs)	feet	3.25	690	2,242	89	288	0	0	11,508	37,400
Improved Pasture Management (SL-10)	acre	300	364	109,200	250	75,000	218	65,400	3,131	939,300
Critical Area Stabilization (SL-11)	acre	2,500	0	0	0	0	0	0	2	5,000
Afforestation of Erodible Pasture (FR-1)	acre	200	0	0	0	0	0	0	22	4,400
Cover Crop (SL-8B, SL-8H)	acre	50	152	7,600	243	12,150	0	0	503	25,150
Total Estimated Agricultural Cost by watershed				**$255,042**		**$121,438**		**$65,400**		**$2,809,250**

Table 6-2. Residential BMP implementation costs for the Buffalo River watershed.

Practice	Unit	Average Unit Cost ($)	upper Buffalo River		Long Branch		middle Buffalo River		Mill Creek		
			Units	Cost	Units	Cost	Units	Cost	Units	Cost	
Septic Tank Pump-out (RB-1)	system	300	69	20,700	9	2,700	435	130,500	58	17,400	Continued
Septic Tank System Repair, Inspection and Maintenance (RB-3, RB-3R)	system	3,500	16	56,000	2	7,000	117	409,500	14	49,000	
Septic Tank System Installation/Replacement (RB4, RB-4P)	system	7,500	0	0	0	0	3	22,500	0	0	
Alternative On-site Waste Treatment System (RB-5)	system	15,000	2	60,000	1	30,000	0	0	1	30,000	
Total Residential Cost by watershed				**$136,700**		**$39,700**		**$562,500**		**$96,400**	

Table 6-2. Residential BMP implementation costs for the Buffalo River watershed (continued).

Practice	Unit	Average Unit Cost ($)	Turner Creek		Rutledge Creek		lower Buffalo River		Total	
			Units	Cost	Units	Cost	Units	Cost	Units	Cost
Septic Tank Pump-out (RB-1)	system	300	247	74,100	600	180,000	692	207,600	2,110	633,000
Septic Tank System Repair, Inspection and Maintenance (RB-3, RB-3R)	system	3,500	62	217,000	146	511,000	157	549,500	514	1,799,000
Septic Tank System Installation/Replacement (RB4, RB-4P)	system	7,500	1	7,500	4	30,000	3	22,500	11	82,500
Alternative On-site Waste Treatment System (RB-5)	system	30,000	1	30,000	2	60,000	0	0	7	210,000
Total Residential Cost by watershed				**$328,600**		**$781,000**		**$779,600**		**$2,724,500**

Table 6-3. Forest BMP implementation costs for the Buffalo River watershed.

Practice	Unit	Average Unit Cost ($)	upper Buffalo River		Long Branch		Total	
			Units	Cost	Units	Cost	Units	Cost
Harvested Forest BMPs	acre	50	179	8,950	12	600	191	9,550
Total Estimated Forest Cost by watershed				**$8,950**		**$600**		**$9,550**

Table 6-4. Total BMP implementation costs by stage for the Buffalo River watershed.

BMP Application	Cost by Stage		Total
	Stage 1 (Years 1 - 5)	Stage 2 (Years 6 - 10)	
Agricultural	$1,405,104	$1,404,146	**$2,809,250**
Residential	$1,660,000	$1,064,500	**$2,724,500**
Forest	$4,800	$4,750	**$9,550**
TOTAL ESTIMATED COST	**$3,069,904**	**$2,473,396**	**$5,543,300**

6.2 Technical Assistance

Technical assistance costs were estimated as one full time position using a cost of $60,000/position per year. This figure is based on the existing staffing costs included in the Virginia Department of Environmental Quality's grant agreements with the Soil and Water Conservation Districts across the state to provide technical assistance to landowners in TMDL implementation watersheds. Based on the 10-year timeline of this plan (described in the Implementation Timeline section of this plan), this would make the total cost of technical assistance approximately $600,000. When factored into the cost estimate for BMP implementation shown in Table 6-4, this would make the total cost of implementation approximately $6.14M.

6.3 Benefit Analysis

The primary benefit of implementing this plan will be cleaner water in the Buffalo River. Specifically, *E. coli* contamination in the river will be reduced to meet water quality standards and sediment in the upper Buffalo River will be reduced to a level at which the river is once again capable of supporting a healthy and diverse community of aquatic life. It is hard to gage the impact that reducing *E. coli* contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the reductions required, the incidence of infection from *E. coli* sources through contact with surface waters should be reduced considerably.

An important objective of the implementation plan is to foster continued economic vitality. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document will provide economic benefits to the community, as well as the expected environmental benefits. Specifically, alternative (clean) water sources, exclusion of livestock from streams, improved pasture management, and private sewage system maintenance will each provide economic benefits to land owners. Additionally, money spent by landowners and state agencies in the process of implementing this plan will stimulate the local economy.

6.3.1 Agricultural Practices

It is recognized that every farmer faces unique management challenges that may make implementation of some BMPs more cost effective than others. Consequently, costs and benefits of the BMPs recommended in this plan must be weighed on an individual basis. The benefits highlighted in this section are based on general research findings.

Restricting livestock access to streams and providing them with a clean water source has been shown to improve weight gain and milk production in cattle (Zeckoski et al., 2007). Studies have shown that increasing livestock consumption of clean water can lead to increased milk and butterfat production and increased weight gain (Landefeld and Bettinger, 2003). Table 6-5 shows an example of how this can translate into economic gains for producers. Fresh clean water is the primary nutrient for livestock, with healthy cattle consuming, on a daily basis, close to 10% of their body weight during winter and 15% of their body weight in summer.

Table 6-5. Example of increased revenue due to installing off-stream waterers (Surber et al., 2003).

Typical calf sale weight	Additional weight gain due to off-stream waterer	Price	Increased revenue due to off-stream waterer
500 lbs/calf	5% or 25 lbs	$0.60 per lb	$15/calf

Many livestock illnesses can be spread through contaminated water supplies. For instance, coccidia can be delivered through feed, water and haircoat contamination with manure (VCE, 2000). Additionally, keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. Horses drinking from marshy areas or areas accessed by wildlife or cattle carrying Leptospirosis tend to have an increased incidence of moonblindness associated with Leptospirosis infections (VCE, 1998a; VCE, 1998b). A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills.

Taking the opportunity to implement an improved pasture management system in conjunction with installing clean water supplies will also provide economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, increase stocking rates by 30 to 40% and, consequently, improve the profitability of the operation. With feed costs typically responsible for 70 to 80% of the cost of growing or maintaining an animal, and pastures providing feed at a cost of 0.01 to 0.02 cents/lb of total digestible nutrients (TDN) compared to 0.04 to 0.06 cents/lb TDN for hay, increasing the amount of time that cattle are fed on pasture is clearly a financial benefit to producers (VCE, 1996). Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. In addition to reducing costs to producers, intensive pasture management can boost profits by allowing higher stocking rates and increasing the amount of gain per acre. Another benefit is that cattle are closely confined allowing for quicker examination and handling. In general, many of the agricultural BMPs recommended in this document will provide both environmental benefits and economic benefits to the farmer.

6.3.2 Residential Septic Practices

The residential programs will play an important role in improving water quality, since human waste can carry human viruses in addition to the bacterial and protozoan pathogens that all fecal matter can potentially carry. In terms of economic benefits to homeowners, an improved understanding of on-site sewage treatment systems, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20 to 25 years if properly maintained. Proper maintenance includes: knowing the location of the system components and protecting them (*e.g.*, not driving or parking on top of them), not planting trees where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every 3 to 5 years. The cost of proper maintenance, as outlined here, is relatively inexpensive ($300) in comparison to repairing or replacing an entire system ($3,500 to $30,000). Additionally, the repair/replacement and pump-out programs will benefit owners of private sewage (*e.g.*, septic) systems, particularly low-income homeowners, by sharing the cost of required maintenance.

6.3.3 Watershed Health and Associated Benefits

Focusing on reducing bacteria and sediment in the watershed will have associated watershed health benefits as well. Reductions in streambank erosion, excessive nutrient runoff, and water temperature are additional watershed health benefits associated with streamside buffer plantings. In turn, reduced nutrient loading and erosion and cooler water temperatures improves habitat for fisheries, which provides associated benefits to anglers and the local economy.

Riparian buffers can also improve habitat for wildlife such as ground-nesting quail and other sensitive species. Data collected from Breeding Bird Surveys in Virginia indicate that the quail population declined 4.2% annually between 1966 and 2007. Habitat loss has been cited as the primary cause of this decline. As a result, Virginia has experienced significant reductions in economic input to rural communities from quail hunting. The direct economic contribution of quail hunters to the Virginia economy was estimated at nearly $26 million in 1991, with the total economic impact approaching $50 million. Between 1991 and 2004, the total loss to the Virginia economy was more than $23 million from declining quail hunter expenditures (VDGIF, 2009). Funding is available to assist landowners in quail habitat restoration (see Chapter 9).

In addition to the benefits to individual landowners, the economy of the local community will be stimulated through expenditures made during implementation, and the infusion of dollars from funding sources outside the impaired areas. Building contractors and material suppliers who deal with septic system pump-outs, private sewage system repair and installation, fencing, and other BMP components can expect to see an increase in business during implementation. Additionally, income from maintenance of these systems should continue long after implementation is complete. As will be discussed in greater detail in Chapter 9, a portion of the funding for implementation can be expected to come from state and federal sources. This portion of funding represents money that is new to the area and will stimulate the local economy. In general, implementation will provide not only environmental benefits to the community, but economic benefits as well, which in turn will allow for individual landowners to participate in implementation.

7. MEASUREABLE GOALS AND MILESTONES

Based upon the scope of work involved with implementing this TMDL, full implementation could be expected within 10 years provided that full funding for technical assistance and BMP cost-share are available. Delisting from the Virginia Section 305(b)/303(d) list can be expected after full implementation, when BMPs attain their maximum reduction efficiencies. A timeline for implementation, water quality and implementation goals and milestones, and strategies for targeting of best management practices are described in this section.

7.1 Milestone Identification

The end goals of implementation are restored water quality of the impaired water and subsequent delisting of the water from the Commonwealth of Virginia's Section 305(b)/303(d) list following implementation. Progress toward end goals will be assessed during implementation through tracking of best management practices through the Virginia Agricultural BMP Cost-Share Program and continued water quality monitoring.

Expected progress in implementation is established with two types of milestones: *implementation milestones* and *water quality milestones*. Implementation milestones establish the amount of control measures installed within certain timeframes, while water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are met. The milestones described here are intended to achieve full implementation within 10 years.

Following the idea of a staged implementation approach, resources and finances will be concentrated on the most cost-efficient control measures and areas of highest interest first. For instance, concentrating on implementing livestock exclusion fencing within the first several years may provide the highest return on water quality improvement with less cost to landowners. Implementation has been divided into two stages: Stage 1 includes years 1 through 5 and Stage 2 includes years 6 through 10. The working group recommended that 50% of the agricultural practices and 60% of the residential practices be implemented in Stage 1 and the remaining implemented in Stage 2. Tables 7-1 through 7-14 show implementation goals, the *E. coli* bacteria and sediment water quality improvement goals, and estimated reductions from each type of BMP for each watershed in each implementation stage.

Table 7-1. Staged implementation goals in the upper Buffalo River watershed for each stage.

BMP Type	Description	BMP code	Units	Extent		
				Stage 1	**Stage 2**	**Total**
Livestock stream exclusion	Stream exclusion with narrow width buffer and grazing land management	SL-6N	feet (system)	25,648 (11)	25,648 (11)	51,296 (22)
	Stream exclusion with wide width buffer and grazing land management	SL-6W		9,160 (4)	9,160 (4)	18,320 (8)
	CREP stream exclusion with grazing land management	CRSL-6		1,832 (1)	1,832 (1)	3,664 (2)
	Exclusion fence maintenance	N/A		3,664	3,664	7,328
Pasture	Improved pasture management	SL-7, SL-10	acres	794	794	1,588
	Afforestation of erodible pasture	FR-1		11	11	22
	Critical area stabilization	SL-11		1	1	2
Residential septic	Onsite sewage system repair	RB-3, RB-3R	repair	10	6	16
	Alternative sewage system	RB-5	system	1	1	2
	Septic tank pump-out	RB-1	pump-out	41	28	69
Forest	Harvested forest BMPs	N/A	acres	90	89	179
Average annual *E. coli* load (x 10^{13} cfu/yr) (Existing = 4.33)				**3.21**	**2.08**	**2.08**
% Exceedance of maximum single sample *E. coli* criterion (235 cfu/100 mL) (Existing = 15.3%)				**10.5%**	**5.2%**	**5.2%**
Average annual sediment load (tons/yr) (Existing LA = 7,500) (TMDL goal = 3,993)				**5,746**	**3,992**	**3,992**
% Reduction in sediment load (TMDL goal = 46.8)				**23.4**	**46.8**	**46.8**

Table 7-2. Estimated bacteria and sediment reductions for each BMP type in the upper Buffalo River watershed.

BMP Type	Description	Estimated Bacteria Reduction (cfu/yr)				Estimated Sediment Reduction (tons/yr)			
		Installed to Date	Stage 1	Stage 2	Total	Installed to Date	Stage 1	Stage 2	Total
Livestock stream exclusion	Livestock Exclusion from Waterway (CRSL-6, SL-6N, SL-6W)	8.96×10^{09}	1.36×10^{11}	1.36×10^{11}	2.80×10^{11}	110	733	733	1,576
Pasture	Improved Pasture Management (SL-7, SL-10)	-	1.08×10^{13}	1.08×10^{13}	2.16×10^{13}	-	910	910	1,820
	Permanent Vegetative Cover on Critical Areas (SL-11)	-	2.51×10^{10}	2.51×10^{10}	5.02×10^{10}	-	2	2	4
	Afforestation of Erodible Pasture (FR-1)	-	3.02×10^{11}	3.02×10^{11}	6.04×10^{11}	-	14	14	28
Cropland	Cover Crop (SL-8B, SL-8H)	6.05×10^{09}	-	-	6.05×10^{09}	19	-	-	19
Residential septic	Septic Tank System Repair, Inspection and Maintenance (RB-3, RB-3R)	-	5.15×10^{08}	3.09×10^{08}	8.24×10^{08}	N/A	N/A	N/A	N/A
	Alternative On-site Waste Treatment System (RB-5)	-	5.15×10^{07}	5.15×10^{07}	1.03×10^{08}	N/A	N/A	N/A	N/A
Forest	Forest Harvesting BMPs	N/A	N/A	N/A	N/A	-	31	30	61
Estimated Total Reduction from existing		1.50×10^{10}	1.12×10^{13}	1.12×10^{13}	2.25×10^{13}	129	1,690	1,689	3,508
Estimated % Reduction from existing		<1%	26%	26%	52%	2%	23%	22%	47%

Table 7-3. Staged implementation goals in the Long Branch watershed for each stage.

BMP Type	Description	BMP code	Units	Extent		
				Stage 1	Stage 2	Total
Livestock stream exclusion	Stream exclusion with narrow width buffer and grazing land management	SL-6N	feet (system)	3,965 (2)	3,964 (2)	7,929 (4)
	Stream exclusion with wide width buffer and grazing land management	SL-6W		1,699 (1)	1,699 (1)	3,398 (2)
	Exclusion fence maintenance	N/A		567	566	1,133
Pasture	Improved pasture management	SL-7, SL-10	acres	60	59	119
Residential septic	Onsite sewage system repair	RB-3, RB-3R	repair	1	1	2
	Alternative sewage system	RB-5	system	1	0	1
	Septic tank pump-out	RB-1	pump-out	5	4	9
Forest	Harvested forest BMPs	N/A	acres	6	6	12
Average annual *E. coli* load (x 10^{13} cfu/yr) (Existing = 0.66)				**0.45**	**0.25**	**0.25**
% Exceedance of maximum single sample *E. coli* criterion (235 cfu/100 mL) (Existing = 27.9)				**19.1%**	**8.7%**	**8.7%**
Average annual sediment load (tons/yr) (Existing LA = 994) (TMDL goal = 466)				**729**	**465**	**465**
% Reduction in sediment load (TMDL goal = 53.1)				**26.7**	**53.2**	**53.2**

Table 7-4. Estimated bacteria and sediment reductions for each BMP type in the Long Branch watershed.

BMP Type	Description	Estimated Bacteria Reduction (cfu/yr)				Estimated Sediment Reduction (tons/yr)			
		Installed to Date	Stage 1	Stage 2	Total	Installed to Date	Stage 1	Stage 2	Total
Livestock stream exclusion	Livestock Exclusion from Waterway (CRSL-6, SL-6N, SL-6W)	-	4.46×10^{10}	4.46×10^{10}	8.92×10^{10}	-	179	179	358
Pasture	Improved Pasture Management (SL-7, SL-10)	-	2.05×10^{12}	1.96×10^{12}	4.01×10^{12}	-	84	83	167
Residential septic	Septic Tank System Repair, Inspection and Maintenance (RB-3, RB-3R)	-	1.36×10^{08}	1.36×10^{08}	2.72×10^{08}	N/A	N/A	N/A	N/A
	Alternative On-site Waste Treatment System (RB-5)	-	1.36×10^{08}	-	1.36×10^{08}	N/A	N/A	N/A	N/A
Forest	Forest Harvesting BMPs	N/A	N/A	N/A	N/A	-	2	2	4
Estimated Total Reduction from existing		-	2.09×10^{12}	2.01×10^{12}	4.10×10^{12}	-	265	264	529
Estimated % Reduction from existing		-	32%	30%	62%	-	27%	26%	53%

Table 7-5. Staged implementation goals in the middle Buffalo River watershed for each stage.

BMP Type	Description	BMP code	Units	Extent		
				Stage 1	Stage 2	Total
Pasture	Improved pasture management	SL-7, SL-10	acres	148	147	295
Residential septic	Onsite sewage system repair	RB-3, RB-3R	repair	70	47	117
	Onsite sewage system installation/replacement	RB-4, RB-4P	system	2	1	3
	Septic tank pump-out	RB-1	pump-out	261	174	435
Average annual *E. coli* load (x 10^{13} cfu/yr) (Existing = 17.65)				**15.40**	**13.44**	**13.44**
% Exceedance of maximum single sample *E. coli* criterion (235 cfu/100 mL) (Existing = 10.7%)				**8.8%**	**6.4%**	**6.4%**

Table 7-6. Estimated bacteria reductions for each BMP type in the middle Buffalo River watershed.

BMP Type	Description	Estimated Bacteria Reduction (cfu/yr)			
		Installed to Date	Stage 1	Stage 2	Total
Livestock stream exclusion	Livestock Exclusion from Waterway (CRSL-6, SL-6N, SL-6W)	$7.18x10^{11}$	-	-	$7.18x10^{11}$
Pasture	Improved Pasture Management (SL-7, SL-10)	-	$2.13x10^{13}$	$2.00x10^{13}$	$4.13x10^{13}$
Cropland	Cover Crop (SL-8B, SL-8H)	$2.22x10^{10}$	-	-	$2.22x10^{10}$
Residential septic	Septic Tank System Repair, Inspection and Maintenance (RB-3, RB-3R)	-	$3.70x10^{10}$	$2.48x10^{10}$	$6.18x10^{10}$
	Septic Tank System Installation/Replacement (RB-4, RB-4P)	-	$1.06x10^{09}$	$5.28x10^{08}$	$1.58x10^{09}$
Estimated Total Reduction from existing		$7.41x10^{11}$	$2.13x10^{13}$	$2.00x10^{13}$	$4.21x10^{13}$
Estimated % Reduction from existing		<1%	12%	11%	24%

Table 7-7. Staged implementation goals in the Mill Creek watershed for each stage.

BMP Type	Description	BMP code	Units	Extent		
				Stage 1	Stage 2	Total
Livestock stream exclusion	Stream exclusion with narrow width buffer and grazing land management	SL-6N	feet (system)	7,939 (3)	7,939 (3)	15,878 (6)
	Stream exclusion with wide width buffer and grazing land management	SL-6W		2,835 (1)	2,835 (1)	5,670 (2)
	CREP stream exclusion with grazing land management	CRSL-6		567 (1)	567 (1)	1,134 (2)
	Exclusion fence maintenance	N/A		1,134	1,134	2,268
Pasture	Improved pasture management	SL-7, SL-10	acres	149	148	297
Cropland	Cover crop	SL-8B, SL-8H	acres	54	54	108
Residential septic	Onsite sewage system repair	RB-3, RB-3R	repair	8	6	14
	Alternative sewage system	RB-5	system	1	0	1
	Septic tank pump-out	RB-1	pump-out	35	23	58
Average annual *E. coli* load (x 10^{13} cfu/yr) (Existing = 1.92)				**1.56**	**1.21**	**1.21**
% Exceedance of maximum single sample *E. coli* criterion (235 cfu/100 mL) (Existing = 29.5%)				**21.2%**	**10.4%**	**10.4%**

Table 7-8. Estimated bacteria reductions for each BMP type in the Mill Creek watershed.

BMP Type	Description	Estimated Bacteria Reduction (cfu/yr)			
		Installed to Date	Stage 1	Stage 2	Total
Livestock stream exclusion	Livestock Exclusion from Waterway (CRSL-6, SL-6N, SL-6W)	-	7.58×10^{10}	7.58×10^{10}	1.52×10^{11}
Pasture	Improved Pasture Management (SL-7, SL-10)	-	3.49×10^{12}	3.45×10^{12}	6.94×10^{12}
Cropland	Cover Crop (SL-8B, SL-8H)	-	1.96×10^{09}	1.96×10^{09}	3.92×10^{09}
Residential septic	Septic Tank System Repair, Inspection and Maintenance (RB-3, RB-3R)	-	8.71×10^{08}	6.53×10^{08}	1.52×10^{09}
	Alternative On-site Waste Treatment System (RB-5)	-	1.09×10^{08}	-	1.09×10^{08}
Estimated Total Reduction from existing		-	3.57×10^{12}	3.53×10^{12}	7.10×10^{12}
Estimated % Reduction from existing		-	19%	18%	37%

Table 7-9. Staged implementation goals in the Turner Creek watershed for each stage.

BMP Type	Description	BMP code	Units	Extent		
				Stage 1	Stage 2	Total
Livestock stream exclusion	Stream exclusion with narrow width buffer and grazing land management	SL-6N	feet (system)	2,415 (1)	2,414 (1)	4,829 (2)
	Stream exclusion with wide width buffer and grazing land management	SL-6W		1,035 (1)	1,035 (1)	2,070 (2)
	Exclusion fence maintenance	N/A		345	345	690
Pasture	Improved pasture management	SL-7, SL-10	acres	182	182	364
Cropland	Cover crop	SL-8B, SL-8H	acres	76	76	152
Residential septic	Onsite sewage system repair	RB-3, RB-3R	repair	37	25	62
	Onsite sewage system installation/replacement	RB-4, RB-4P	system	1	0	1
	Alternative sewage system	RB-5		1	0	1
	Septic tank pump-out	RB-1	pump-out	148	99	247
Average annual *E. coli* load (x 10^{13} cfu/yr) (Existing = 1.87)				**1.48**	**1.12**	**1.12**
% Exceedance of maximum single sample *E. coli* criterion (235 cfu/100 mL) (Existing = 23.2)				**17.7%**	**10.4%**	**10.4%**

Table 7-10. Estimated bacteria reductions for each BMP type in the Turner Creek watershed.

BMP Type	Description	Estimated Bacteria Reduction (cfu/yr)			
		Installed to Date	Stage 1	Stage 2	Total
Livestock stream exclusion	Livestock Exclusion from Waterway (CRSL-6, SL-6N, SL-6W)	$1.03x10^{10}$	$5.95x10^{10}$	$5.95x10^{10}$	$1.29x10^{11}$
Pasture	Improved Pasture Management (SL-7, SL-10)	-	$3.68x10^{12}$	$3.68x10^{12}$	$7.36x10^{12}$
Cropland	Cover Crop (SL-8B, SL-8H)	-	$2.51x10^{09}$	$2.51x10^{09}$	$5.02x10^{09}$
Residential septic	Septic Tank System Repair, Inspection and Maintenance (RB-3, RB-3R)	-	$3.71x10^{09}$	$2.51x10^{09}$	$6.22x10^{09}$
	Septic Tank System Installation/Replacement (RB-4, RB-4P)	-	$1.00x10^{08}$	-	$1.00x10^{08}$
	Alternative On-site Waste Treatment System (RB-5)	-	$1.00x10^{08}$	-	$1.00x10^{08}$
Estimated Total Reduction from existing		$1.03x10^{10}$	$3.75x10^{12}$	$3.74x10^{12}$	$7.50x10^{12}$
Estimated % Reduction from existing		<1%	20%	20%	40%

Table 7-11. Staged implementation goals in the Rutledge Creek watershed for each stage.

BMP Type	Description	BMP code	Units	Extent: Stage 1	Extent: Stage 2	Extent: Total
Livestock stream exclusion	Stream exclusion with narrow width buffer and grazing land management	SL-6N	feet (system)	887 (1)	0	887 (1)
	Exclusion fence maintenance	N/A		45	44	89
Pasture	Improved pasture management	SL-7, SL-10	acres	125	125	250
Cropland	Cover crop	SL-8B, SL-8H	acres	122	121	243
Residential septic	Onsite sewage system repair	RB-3, RB-3R	repair	88	58	146
	Onsite sewage system installation/replacement	RB-4, RB-4P	system	2	2	4
	Alternative sewage system	RB-5		1	1	2
	Septic tank pump-out	RB-1	pump-out	360	240	600
Average annual *E. coli* load (x 10^{13} cfu/yr) (Existing = 4.38)				**3.62**	**2.93**	**2.93**
% Exceedance of maximum single sample *E. coli* criterion (235 cfu/100 mL) (Existing = 21.6%)				**16.9%**	**10.1%**	**10.1%**

Table 7-12. Estimated bacteria reductions for each BMP type in the Rutledge Creek watershed.

BMP Type	Description	Estimated Bacteria Reduction (cfu/yr) Installed to Date	Stage 1	Stage 2	Total
Livestock stream exclusion	Livestock Exclusion from Waterway (CRSL-6, SL-6N, SL-6W)	6.85×10^{11}	1.41×10^{11}	-	8.26×10^{11}
Pasture	Improved Pasture Management (SL-7, SL-10)	-	6.80×10^{12}	6.80×10^{12}	1.36×10^{13}
Cropland	Cover Crop (SL-8B, SL-8H)	-	1.09×10^{10}	1.09×10^{10}	2.18×10^{10}
Residential septic	Septic Tank System Repair, Inspection and Maintenance (RB-3, RB-3R)	-	2.64×10^{10}	1.74×10^{10}	4.38×10^{10}
	Septic Tank System Installation/Replacement (RB-4, RB-4P)	-	5.99×10^{08}	5.99×10^{08}	1.20×10^{09}
	Alternative On-site Waste Treatment System (RB-5)	-	3.00×10^{08}	3.00×10^{08}	6.00×10^{08}
Estimated Total Reduction from existing		6.85×10^{11}	6.98×10^{12}	6.83×10^{12}	1.45×10^{13}
Estimated % Reduction from existing		1%	16%	16%	33%

Table 7-13. Staged implementation goals in the lower Buffalo River watershed for each stage.

BMP Type	Description	BMP code	Units	Extent		
				Stage 1	Stage 2	Total
Pasture	Improved pasture management	SL-7, SL-10	acres	109	109	218
Residential septic	Onsite sewage system repair	RB-3, RB-3R	repair	94	63	157
	Onsite sewage system installation/replacement	RB-4, RB-4P	system	2	1	3
	Septic tank pump-out	RB-1	pump-out	415	277	692
Average annual *E. coli* load (x 10^{13} cfu/yr) (Existing = 31.13)				**28.12**	**25.73**	**25.73**
% Exceedance of maximum single sample *E. coli* criterion (235 cfu/100 mL) (Existing = 11.4%)				**9.8%**	**8.8%**	**8.8%**

Table 7-14. Estimated bacteria reductions for each BMP type in the lower Buffalo River watershed.

BMP Type	Description	Estimated Bacteria Reduction (cfu/yr)			
		Installed to Date	Stage 1	Stage 2	Total
Livestock stream exclusion	Livestock Exclusion from Waterway (CRSL-6, SL-6N, SL-6W)	5.90×10^{11}	-	-	5.90×10^{11}
Pasture	Improved Pasture Management (SL-7, SL-10)	-	2.66×10^{13}	2.66×10^{13}	5.32×10^{13}
Residential septic	Septic Tank System Repair, Inspection and Maintenance (RB-3, RB-3R)	-	9.63×10^{10}	6.45×10^{10}	1.61×10^{11}
	Septic Tank System Installation/Replacement (RB-4, RB-4P)	-	2.05×10^{09}	1.02×10^{09}	3.07×10^{09}
Estimated Total Reduction from existing		5.90×10^{11}	2.67×10^{13}	2.67×10^{13}	5.40×10^{13}
Estimated % Reduction from existing		<1%	9%	8%	17%

7.2 Water Quality Monitoring

7.2.1 DEQ Monitoring

Improvements in water quality will be evaluated through water quality monitoring conducted at DEQ monitoring stations located in the watersheds as shown in Table 7-15 and Figure 3-3. Monitoring will begin no sooner than the second odd numbered calendar year following the initiation of TMDL implementation. Beginning implementation monitoring after 2 to 3 years of TMDL implementation will help ensure that time has passed for remedial measures to have stabilized and BMPs to have become functional.

Table 7-15. Water quality monitoring stations used to evaluate implementation in the Buffalo River watershed.

Station ID	Impairment Type	Stream Name	Station Description
2-BUF002.10	bacteria	Buffalo River	Route 657 at gaging station
2-BUF013.53	bacteria	Buffalo River	Route 29 bridge
2-BUF023.21	bacteria	Buffalo River	Route 778 bridge, NW of Amherst
2-BUF026.43	benthic	Buffalo River	Route 60
2-LOB000.37	benthic	Long Branch	off Route 60
2-MIN002.25	bacteria	Mill Creek	Route 778 Lowesville Rd
2-RTD003.08	bacteria	Rutledge Creek	below Amherst STP Outfall
2-RTD007.61	bacteria	Rutledge Creek	Sweetbriar entrance
2-TNR000.25	bacteria	Turner Creek	Route 739 Boxwood Farm Rd

For the bacteria impairments, most of the stations are part of DEQ's Ambient Monitoring Program, wherein bi-monthly watershed monitoring takes place on a rotating basis for two consecutive years of a six-year assessment cycle. At a minimum, the frequency of sample collections will be every other month for two years. After two years of bi-monthly monitoring an evaluation will be made to determine if the segments have been restored. If so, high frequency monitoring will then be conducted to assess the segments potential for delisting. If full restoration, as defined in the current or most recent version of the DEQ Final Water Quality Assessment Guidance Manual, has been achieved, monitoring will be suspended. If the listing stations shown in Table 7-15**Error! Reference source not found.**, or any other stations associated with this implementation plan have three or more exceedances of the bacteria standard within this two-year period, monitoring will be discontinued for two years. Bi-monthly monitoring will be resumed for another two years on the odd numbered calendar year in the third two-year period of the six-year assessment window. After this, the most recent two years of data will be evaluated, and the same criteria as was used for the first two-year monitoring cycle will apply.

For the benthic impairments, DEQ will conduct biological monitoring at the two original listing stations. This monitoring will be conducted twice a year in the spring and fall for approximately two years.

7.2.2 Citizen Monitoring

Citizen monitoring is another valuable tool for assessing water quality. Citizen monitoring can supplement DEQ monitoring, identify priority areas for implementation, and detect improvements in water quality following implementation. DEQ offers information on Citizen Water Quality Monitoring at https://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx.

7.3 Prioritizing Implementation Actions

Staged implementation implies the process of prioritizing BMPs to achieve the greatest bacteria and sediment reduction benefits early in the process. For example, practices that reduce bacteria from residential septic systems and straight pipes are considered 100% effective. Since malfunctioning septic systems contributing sewage to surface water or groundwater and straight pipes are illegal it will be essential to focus on these human sources. Thus, the majority of residential practices will be implemented in Stage 1. Prioritizing different BMPs across the stages optimizes the use of limited resources by focusing on the most cost-effective practices and those that present the least obstacles (acceptance by landowners, available cost-share, etc.)

Implementation actions were also prioritized spatially based on watershed inventory and optimum utilization of limited technical and financial resources. The Buffalo River sub-watersheds first described in Chapter 5 were divided into small areas to identify focus areas for prioritization of agricultural and residential BMPs (Figure 7-1 and Figure 7-2). Factors used to develop BMP priorities were human and livestock health risks, effectiveness of BMPs, stakeholder interest, costs, and ease of installation. The distribution of implementation milestones listed in Tables 7-1 through 7-14 correspond with these priorities.

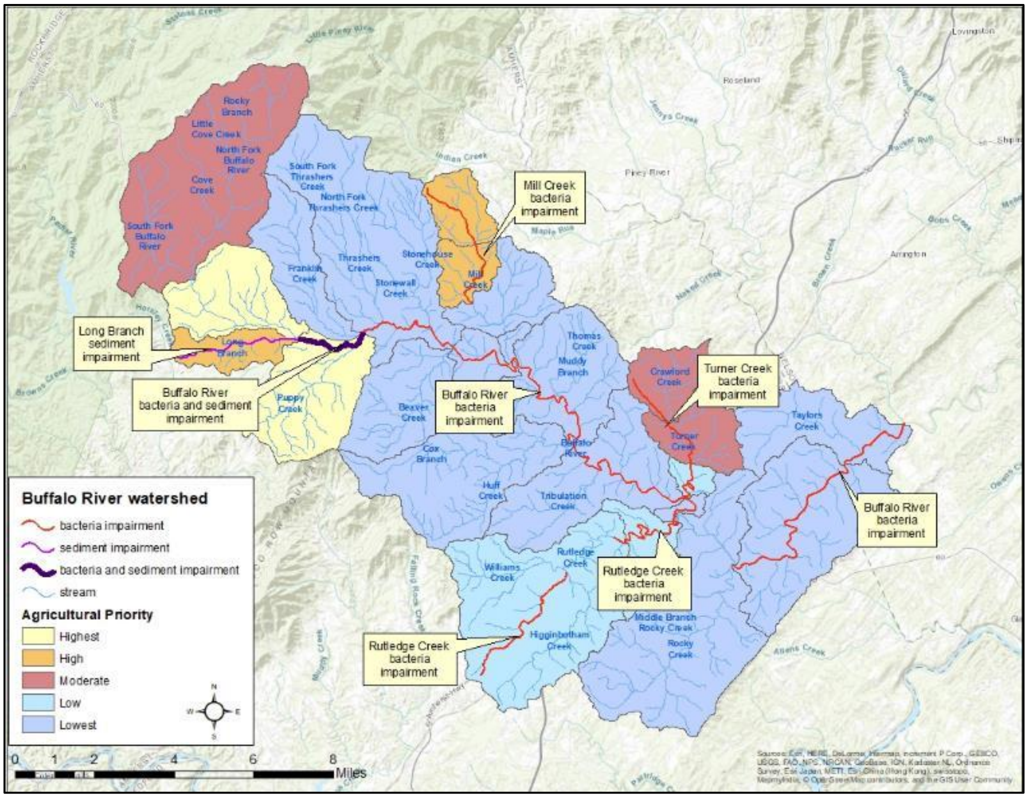

Figure 7-1. Agricultural prioritization by sub-watershed for the Buffalo River watershed.

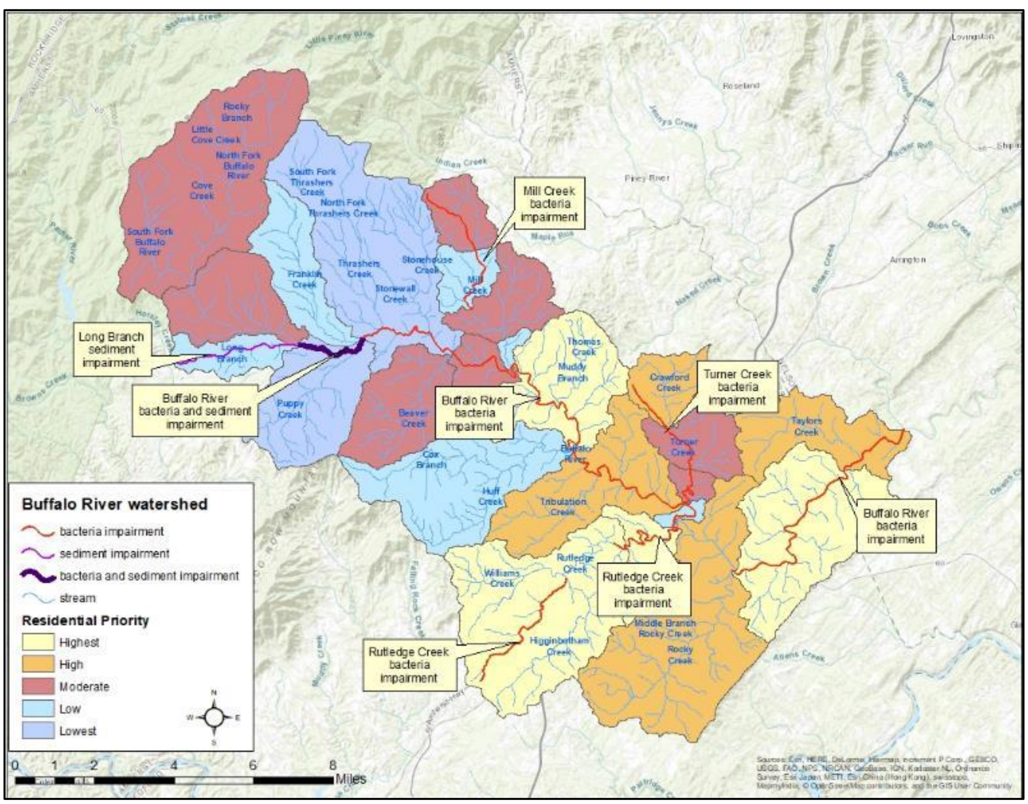

Figure 7-2. Residential prioritization by sub-watershed for the Buffalo River watershed.

An adaptive management strategy will be utilized in the implementation of this plan. Throughout the course of implementation, the management measures and water quality goals will be assessed and adjustments of actions will be made as appropriate. As new technologies and innovative BMPs to address bacteria reduction become available, these practices will be evaluated for implementation in the watershed. Other developments, for example, an extension of the county's sewer lines, could also result in an adaptation of the original implementation plan. In addition, as new funding opportunities become available, they will be reviewed and pursued if applicable in the Buffalo River watershed.

8. STAKEHOLDERS AND THEIR ROLE IN IMPLEMENTATION

Achieving the goals of this plan is dependent on stakeholder participation and strong leadership on the part of both community members and conservation organizations. The Robert E. Lee Soil & Water Conservation District covers all of the project area with respect to administration of the VA Agricultural BMP Cost-Share Program. Additional partners will be necessary in order to address residential implementation needs. The following sections in this chapter describe the responsibilities and expectations for the various components of implementation.

8.1 Partner Roles and Responsibilities

8.1.1 Watershed Landowners

Participation by homeowners and local farmers are equally important in the success of this implementation plan. Residential property owners will need to repair or replace any malfunctioning septic system, and ensure that their septic systems continue to work properly by regularly pumping and inspection (every 3 to 5 years). SWCD and NRCS conservation staff will work with farmers to select the most applicable and cost-efficient practices for their farms. To assist with this selection, it is important to consider characteristics of farms and farmers in the watersheds that will affect the decisions farmers make when it comes to implementing conservation practices on their farms. For example, the average size of farms is an important factor to consider, since it affects how much land a farmer can give up for a riparian buffer. The average age of a farmer, which was 58 in Virginia in 2017, may also influence their decision to implement best management practices, particularly if they are close to retirement and will be relying on the sale of their land for income during retirement. In such cases, it may be less likely that a farmer would be willing to invest a portion of their income in best management practices. Table 8-1 provides a summary of relevant characteristics of farmers and producers in Amherst County from the 2017 Agricultural Census (USDA-NASS, 2017). These characteristics were considered when developing implementation scenarios, and should be utilized to develop suitable education and outreach strategies.

In addition to local farmers and homeowners, participation from elected officials is critical to the success of this plan. Elected officials make important decisions with respect to land use and development that are likely to affect water quality. It is critical that the goals of this plan are considered as these decisions are evaluated.

Table 8-1. Characteristics of farms and farmers in Amherst County (USDA-NASS, 2017).

Characteristic	Extent
Number of farms	369
Land in farms (acres)	78,812
Full owners of farms	256
Part owners of farms	93
Tenants	20
Operators identifying farming as their primary occupation	207
Operators identifying something other than farming as their primary occupation	274
Average years present on the farm	22
Average age of primary operator	62
Average size of farm (acres)	214
Average value of farmland and buildings ($/acre)	$4,654
Average net cash farm income of operation ($)	$2,292
Farms with internet access	264
Farm typology (farms)	
Family or individual	90%
Partnership	2%
Family-held corporation	5%
Corporation other than family held	<1%
Other (cooperative, estate or trust, institutional etc.)	2%

8.1.2 Robert E. Lee Soil & Water Conservation District (SWCD)

The SWCD is continually reaching out to farmers in the watersheds and providing them technical assistance with conservation practices. Currently, dedicated staff is not available to work solely in the Buffalo River watershed, meaning that agricultural BMP implementation goals cannot be met without additional resources. SWCD staff responsibilities include promoting available funding for BMPs and aiding in the design and layout of agricultural BMPs. SWCD staff can assist with conducting outreach activities in the watersheds to encourage participation in conservation programs; however, staff time for targeted outreach is limited due to existing workloads. Should funding for additional staff become available for outreach in these watersheds, the Robert E. Lee SWCD would be well suited to administer an agricultural BMP program.

Residential septic system practices, outreach and funding could be administered by a number of different entities including the Robert E. Lee SWCD or the Amherst County Health Department.

8.1.3 Natural Resource Conservation Service (NRCS)

The U.S. Department of Agriculture, NRCS, is the federal agency that works hand-in-hand with US citizens to conserve natural resources on private lands. NRCS assists private landowners with conserving their soil, water, and other natural resources. Local, state and federal agencies and policymakers also rely on the expertise of NRCS staff. NRCS is also a major funding stakeholder for impaired water bodies through CREP and the Environmental Quality Incentives Program (EQIP).

8.1.4 U.S. Environmental Protection Agency

EPA has the responsibility of overseeing the various programs necessary for the success of the CWA. However, administration and enforcement of such programs falls largely to the states. Section 303(d) of the CWA and current EPA regulations do not require the development of TMDL IPs. EPA has outlined nine minimum elements of an approvable IP for states to receive Section 319 funding for IP development and implementation.

8.1.5 Amherst County

Decisions made by local government staff and elected officials regarding land use and zoning will play an important role in the implementation of this plan. This makes the County a key partner in long term implementation efforts.

8.1.6 Virginia Department of Environmental Quality

The Virginia Department of Environmental Quality (DEQ) has a lead role in the development of TMDLIPs to address non-point source pollutants such as bacteria from straight pipes, failing septic systems, pet waste, agricultural operations, and stormwater that contribute to water quality impairments. DEQ provides available grant funding and technical support for the implementation of NPS (non-point source) components of TMDL IPs. DEQ will work closely with project partners including the Robert E. Lee Soil & Water Conservation District to track implementation progress for best management practices. In addition, DEQ will work with interested partners on grant proposals to generate funds for BMPs and projects included in the implementation plan. When needed, DEQ will facilitate additional meetings of the working group to discuss implementation progress and make necessary adjustments to the implementation plan.

DEQ is also responsible for monitoring state waters to determine compliance with water quality standards. DEQ will continue monitoring water quality in Buffalo River in order to assess water quality and determine when restoration has been achieved and the stream can be removed from Virginia’s impaired waters list.

8.1.7 Virginia Department of Conservation and Recreation

The Virginia Department of Conservation and Recreation (VADCR) administers the Virginia Agricultural BMP Cost-Share Program, working closely with Soil & Water Conservation Districts to provide cost-share and operating grants needed to deliver this program at the local level. VADCR works with the SWCDs to track BMP implementation as well. In addition, VADCR administers the state’s Nutrient Management Program, which provides guidelines and technical assistance to producers in appropriate manure and poultry litter storage and application, as well as application of commercial fertilizer.

8.1.8 Virginia Department of Health

The Virginia Department of Health (VDH) is responsible for adopting and implementing regulations for onsite wastewater treatment and disposal. The Sewage Handling and Disposal Regulations require homeowners to secure permits for handling and disposal of sewage (e.g. repairing a failing septic system or installing a new treatment system). VDH staff provides technical assistance to homeowners with septic system maintenance and installation, and respond to complaints regarding failing septic systems.

8.1.9 Other Potential Local Partners

There are numerous opportunities for future partnerships in the implementation of this plan and associated water quality monitoring. A list of additional organizations and entities with which partnership opportunities should be explored is provided below:

- Local Ruritan Clubs
- Central Virginia Planning District Commission
- Virginia Cooperative Extension
- Virginia Department of Housing and Community Development
- Virginia Department of Agriculture and Consumer Services
- Virginia Department of Forestry
- Virginia Department of Transportation

8.2 Integration with Other Watershed Plans

Each watershed in the state is under the jurisdiction of a multitude of individual yet related water quality programs and activities, many of which have specific geographic boundaries and goals. These include but are not limited to TMDLs, Water Quality Management Plans, Source Water Protection Programs, and local comprehensive plans. Coordination of the implementation project with these existing programs could result in additional resources and increased participation.

8.2.1 Amherst County Comprehensive Plan

Amherst County adopted their current Comprehensive Plan in 2007 and updated it most recently in 2017. The plan is intended to guide development and natural resource management within the jurisdiction. The plan stresses the citizens' "overwhelming desire to protect natural resources" and "retain the rural nature of the County." The plan also notes the County's commitment to "preserve and enhance water quality within the watersheds of the County's public drinking water sources."

8.3 Legal Authority

The EPA has the responsibility of overseeing the various programs necessary for the success of the CWA. However, administration and enforcement of such programs falls largely to the states. In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are four state agencies responsible for regulating activities that impact bacteria impaired streams in Virginia. These agencies are DEQ, VADCR, VDH, and Virginia Department of Agriculture and Consumer Services (VDACS).

DEQ has responsibility for monitoring waters to determine compliance with state standards, and for requiring permitted point dischargers to maintain loads within permit limits. It has the regulatory authority to levy fines and take legal action against those in violation of permits. Beginning in 1994, animal waste from confined animal facilities that hold in excess of 300 animal units (cattle and hogs) has been managed through a Virginia general pollution abatement permit. These operations are required to implement a number of practices to prevent surface and groundwater contamination. In response to increasing demand from the public to develop new regulations dealing with animal waste, the Virginia General Assembly passed legislation in 1999 requiring DEQ to develop regulations for the management of poultry waste in operations having more than 200 animal units of poultry (about 20,000 chickens) (ELI, 1999).

VADCR is responsible for administering the Virginia Agricultural BMP Cost-Share and Nutrient Management Programs. Historically, most VADCR programs have dealt with agricultural NPS pollution through education and voluntary incentives. These cost-share programs were originally developed to meet the needs of voluntary partial participation and not the level of participation required by TMDLs (near 100%). To meet the needs of the TMDL program and achieve the goals set forth in the CWA, the incentive programs are continually reevaluated to account for this level of participation.

Through Virginia's Agricultural Stewardship Act (ASA), the Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis (Pugh, 2001). If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken which can include a civil penalty of up to $5,000 per day. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures. VDACS has three staff members dedicated to enforcing the Agricultural Stewardship Act, and a small amount of funding is available to support water quality sampling. The Agricultural Stewardship Act is entirely complaint-driven.

VDH is responsible for maintaining safe drinking water measured by standards set by the EPA. Their duties also include septic system regulation and, historically, regulation of biosolids land application on permitted farmland sites. Like VDACS, VDH’s actions are complaint-driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation that may take many weeks or longer to effect compliance. In relation to these TMDLs, VDH has the responsibility of enforcing actions to correct or eliminate failed septic systems and straight pipes.

State government has the authority to establish state laws that control delivery of pollutants to local waters. Local governments, in conjunction with the state, can develop ordinances involving pollution prevention measures. In addition, citizens have the right to bring litigation against persons or groups of people shown to be causing some harm to the claimant. The judicial branch of government also plays a significant role in the regulation of activities that impact water quality through hearing the claims of citizens in civil court and the claims of government representatives in criminal court.

8.4 Legal Action

The Clean Water Act Section 303(d) calls for the identification of impaired waters. It also requires that the streams be ranked by the severity of the impairment and that TMDLs be calculated for streams to meet water quality standards. TMDL implementation plans are not required in the Federal Code; however, Virginia State Code does include the development of implementation plans for impaired streams. EPA largely ignored the nonpoint source section of the Clean Water Act until citizens began to realize that regulating only point sources was no longer maintaining water quality standards. Lawsuits from citizens and environmental groups citing EPA for not carrying out the statutes of the CWA began as far back as the 1970s and have continued until the present. In Virginia in 1998, the American Canoe Association and the American Littoral Society filed a complaint against EPA for failure to comply with provisions of §303(d). The suit was settled by Consent Decree, which contained a TMDL development schedule through 2010. It is becoming more common for concerned citizens and environmental groups to turn to the courts for the enforcement of water quality issues.

Successful implementation depends on stakeholders taking responsibility for their role in the process. The primary role, of course, falls on the landowner. However, local, state and federal agencies also have a stake in ensuring that Virginia’s waters are clean and provide a healthy environment for its citizens. An important first step in correcting the existing water quality problem is recognizing that there is a problem and that the health of citizens is at stake. Virginia’s approach to correcting NPS pollution problems has been, and continues to be, encouragement of participation through education and financial incentives.

9. POTENTIAL FUNDING SOURCES

A list of potential funding sources available for implementation has been developed. A brief description of the programs and their requirements is provided in this chapter. Detailed descriptions can be obtained from the SWCD, DEQ, VADCR, NRCS, and VCE.

9.1 Virginia Nonpoint Source Implementation Program

Virginia's nonpoint source (NPS) implementation program is administered by DEQ through local Soil and Water Conservation Districts (SWCD), local governments, nonprofits, planning district commissions (PDC), and local health departments to improve water quality in the Commonwealth's streams and rivers and in the Chesapeake Bay. DEQ, through its partners, provides cost-share assistance to landowners, homeowners, and agricultural operators as an incentive to voluntarily install nonpoint source (NPS) best management practices (BMPs) in designated watersheds. The program uses funds from a variety of sources, including EPA 319(h) and the state-funded Water Quality Improvement Fund (WQIF) to install BMPs with the goal of ultimately meeting Virginia's NPS pollution water quality objectives. Although resource-based problems affecting water quality can occur on all land uses, this program addresses cost-share assistance on agricultural, residential, and urban lands. The geographic extent of eligible lands is identified in grant agreements and in watershed-based plans (WBPs), including TMDL IPs approved by DEQ and EPA.

9.2 Virginia Agricultural Best Management Practices Cost-Share Program (VACS)

The cost-share program is funded with state and federal monies through local SWCDs. SWCDs administer the program to encourage farmers and landowners to use BMPs on their land to better control transportation of pollutants into our waters due to excessive surface flow, erosion, leaching, and inadequate animal waste management. Program participants are recruited by SWCDs based upon those factors, which have a great impact on water quality. Cost-share is typically 75% of the actual cost, not to exceed the state maximum.

9.3 Virginia Agricultural Best Management Practices Tax Credit Program

For all taxable years, any individual or corporation engaged in agricultural production for market, who has in place a soil conservation plan approved by the local SWCD, is allowed a credit against the tax imposed by Section 58.1-320 of an amount equaling 25% of the first $70,000 expended for agricultural best management practices by the individual. Any practice approved by the local SWCD Board must be completed within the taxable year in which the credit is claimed. The credit is only allowed for expenditures made by the taxpayer from funds of his/her own sources. The amount of the credit cannot exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed. If the amount of the credit exceeds the taxpayer's state tax obligation, the excess will be refunded to the taxpayer by the Virginia Department of Taxation. This program can be used independently or in conjunction with other cost-share programs on the stakeholder's portion of BMP costs. It is also approved for use in supplementing the cost of repairs to streamside fencing.

Tax credits are also available for the purchase of precision agricultural equipment and conservation tillage equipment. This includes manure applicators, sprayers, variable rate application equipment, and equipment used to reduce soil compaction. Individuals may claim a state tax credit of 25% of all expenditures made for purchasing and installing the equipment, up to a set maximum amount. A Nutrient Management Plan approved by the local SWCD is required to claim these credits.

9.4 Virginia Conservation Assistance Program (VCAP)

This is a relatively new program that provides financial incentives and technical and educational assistance to residential/urban landowners who install stormwater BMPs in Virginia's Chesapeake Bay watershed. Cost-share is typically 75% and some practices provide a flat incentive payment. SWCDs administer the program to encourage residential and urban property owners to install BMPs on their land to reduce erosion, poor drainage, and poor vegetation that contribute to water quality problems.

9.5 Virginia Water Quality Improvement Fund (WQIF)

This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient loads to surface waters. Eligible recipients include local governments, SWCDs, and individuals. Grants for both point and nonpoint source pollution remediation are administered through DEQ.

9.6 Conservation Reserve Program (CRP)

Through this program, cost-share assistance is available to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Applications for the program are ranked, accepted and processed during signup periods that are announced by the Farm Service Agency (FSA). If accepted, contracts are developed for a minimum of 10 and not more than 15 years. To be eligible for consideration, land and applicants must meet certain criteria set by FSA. Payments may include cost share for practice establishment, incentive payments, and rental payments on enrolled acres.

9.7 Conservation Reserve Enhancement Program (CREP)

This program is an "enhancement" of the existing USDA Conservation Reserve Program. It has been enhanced by combining federal funds with state funds in a partnership to address high priority conservation concerns. In exchange for removing environmentally sensitive land from production and establishing permanent resource conserving plant species, farmers are paid an annual rental rate along with state and federal incentives. Contracts are typically established for 10 or 15 years in support of CREP goals, which include reducing sediment, nutrients, nitrogen and other pollutants entering waterbodies, reducing soil erosion, wetland restoration, and enhancement of wildlife habitat.

The landowner can obtain and complete CREP application forms at the FSA center. The forms are forwarded to local NRCS and SWCD offices while FSA determines land eligibility. If the land is deemed eligible, NRCS and the local SWCD determine and design appropriate conservation practices. A conservation plan is written, and fieldwork is begun, which completes the conservation practice design phase.

FSA then measures CREP acreage, conservation practice contracts are written, and practices are installed. The landowner submits bills for cost-share reimbursement to FSA. Once the landowner completes BMP installation and the practice is approved, FSA and the SWCD make the cost-share payments. The SWCD also pays out the state's one-time, lump sum rental payment. FSA conducts random spot checks throughout the life of the contract, and the agency continues to pay annual rent throughout the contract period.

9.8 Environmental Quality Incentives Program (EQIP)

This program was established in the 1996 Farm Bill to provide a single voluntary conservation program for farmers and landowners to address significant natural resource needs and objectives. EQIP is administered by NRCS and offers landowners and farmers cost-share assistance to implement a wide range of conservation practices on agricultural and forest land. Applications are ranked and priority is given to conservation practices that will result in greater environmental benefits.

9.9 EPA Water Infrastructure Finance and Innovation Act (WIFIA) Funds

The WIFIA program was established by the Water Infrastructure Finance and Innovation Act of 2014. WIFIA provides long-term, low-cost supplemental loans for regionally and nationally significant projects. The funds can be used for development and implementation activities for eligible projects including, but not limited to, wastewater conveyance and treatment, drinking water treatment and distribution, enhanced energy efficiency projects at drinking water and wastewater facilities, acquisition of property if it is integral to the project or will mitigate the environmental impact of a project, and combinations of eligible projects. Loans can be combined with other funding sources including state Revolving Fund loans.

9.10 Southeast Rural Community Assistance Project (SERCAP)

The mission of this project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. Staff members of other community organizations complement the SERCAP staff across the region. They can provide (at no cost): on-site technical assistance and consultation, operation and maintenance/management assistance, training, education, facilitation, volunteers, and financial assistance. Financial assistance includes loans and small grants toward repair/replacement/installation of a septic system or an alternative waste treatment system. Funding is available for low-income homeowners.

9.11 National Fish and Wildlife Foundation (NFWF)

Grant proposals for this funding are accepted throughout the year and processed during fixed signup periods. There are two decision cycles per year. Each cycle consists of a pre-proposal evaluation, a full proposal evaluation, and a Board of Directors' decision. Grants are awarded for the purpose of conserving fish, wildlife, plants, and their habitats. Special grant programs are listed and described on the NFWF website (http://www.nfwf.org). If the project does not fall into the criteria of any special grant programs, a proposal may be submitted as a general grant if it falls under the following guidelines: 1) it promotes fish, wildlife and habitat conservation, 2) it involves other conservation and community interests, 3) it leverages available funding, and 4) project outcomes are evaluated.

9.12 Clean Water State Revolving Fund

EPA awards grants to states to capitalize their Clean Water State Revolving Funds (CWSRFs). The states, through the CWSRF, make loans for high-priority water quality activities. As loan recipients make payments back into the fund, money is available for new loans to be issued to other recipients. Eligible projects include point source, nonpoint source and estuary protection projects. Point source projects typically include building wastewater treatment facilities, combined sewer overflow and sanitary sewer overflow correction, urban stormwater control, and water quality aspects of landfill projects. Nonpoint source projects include agricultural, silvicultural, rural, and some urban runoff control; on-site wastewater disposal systems (septic tanks); land conservation and riparian buffers; leaking underground storage tank remediation, etc.

9.13 Wetland and Stream Mitigation Banking

Mitigation banks are sites where aquatic resources such as wetlands, streams and streamside buffers are restored, created, enhanced, or in exceptional circumstances, preserved expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources. Mitigation banking is a commercial venture that provides compensation for aquatic resources in financially and environmentally preferable ways. Not every site or property is suitable for mitigation banking. Mitigation banks are required to be protected in perpetuity, to provide financial assurances and long term stewardship. The mitigation banking process is overseen by an Inter-Agency Review Team made up of state and federal agencies and chaired by DEQ and the Army Corps of Engineers.

9.14 Indoor Plumbing Rehabilitation (IPR) Program

The Virginia DHCD also offers the IPR loan program to low- and moderate-income homeowners who do not have indoor plumbing or have a failed wastewater disposal system. The IPR program provides zero-interest, subsidized loans with repayments tailored to individual borrower circumstances.

9.15 Other Potential Funding Sources

Additional potential funding sources that have been identified by the working groups or in previous TMDL IPs include:

- Virginia Outdoors Foundation. *For more information:* http://www.virginiaoutdoorsfoundation.org/, accessed 12/5/2019.
- U. S. Fish and Wildlife Service (FWS) Conservation Grant Program. *For more information:* https://www.fws.gov/grants/, accessed 12/5/2019.
- USDA Agricultural Conservation Easement Program. *For more information:* https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/, accessed 12/5/2019.
- Virginia Environmental Endowment. *For more information:* http://www.vee.org, accessed 12/5/19.
- Trout Unlimited. *For more information:* https://www.tu.org/, accessed 12/5/2019.
- Ducks Unlimited. *For more information:* https://www.ducks.org/, accessed 12/5/2019.

As part of adaptive management, the state recognizes that other funding opportunities may become available. These opportunities will be utilized if appropriate.

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